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UNITED STATES
Department of the Interior
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BUREAU OF MINES
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CHANGE HOUSES IN THE LAKE SUPERIOR DISTRICT

BY

Frank E. Cash and Roy G. Stott

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UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

CHANGE HOUSES IN THE LAKE SUPERIOR DISTRICT[1]

By Frank E. Cash[2] and Roy G. Stott[3]

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INTRODUCTION

This circular describes four modern change houses of the Lake Superior iron-ore district, all conceived and constructed since 1937. The oldest change house described herein was constructed and occupied in 1938, yet it embodies the modern improvement of air-conditioning. The purpose of this report is to describe and illustrate improvements with regard to health and safety features combined in the construction, arrangement, ventilation, heating, lighting, and other features, with the aid of photographs, sketches, and diagrams.

The modern change house is a fire-resistant structure in which intermingling of men in mine clothes and men in street clothes, hazardous dust, heat and humidity, crowding, poor lighting, slippery and muddy floors, and inadequate facilities for clothes and for bathing have been largely eliminated.

The miner coming off shift at a modern mine no longer faces the elements when he gets off the cage. He travels through a tunnel to the change house, where he is cooled gradually by room temperatures as he passes from the mine-clothes section and shower room to the street-clothes room. He is assured of dry clothes when he is ready for them. No longer is he sent out of the change house into a muddy yard to drive away as best he can. The modern change house has an improved parking lot and graveled or concreted walkways from it to the change house entrances.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the cooperation of the mining companies whose personnel made possible the collection of the information contained in this circular. The following companies assisted in this work: Castile mining Co., Cleveland-Cliffs Iron Co., M. A. Hanna Co., and Inland Steel Co.

MINE A

General Information

Change house A, which was designed to accommodate approximately 300 employees, was constructed in 1938 to replace an older structure. It occupies the basement or first floor of a two-story steel and masonry building 50 feet 8 inches wide by 143 feet 8 inches long. The second or ground-level floor serves as a garage and warehouse.

The surface structures, as shown in figure 1, consist of the change house (in the foreground), the shop building adjacent thereto (in the center), the hoist house (at the right), and the shaft head frame (in the center background). The change house and shop building are connected to the shaft cage landing by branching underground tunnels. A parking lot for the use of employees is provided 350 feet east of and across the highway from the change house. A concrete walk connects the parking lot with the change house.

Construction

The first story is constructed of 12-inch reinforced-concrete walls 13 feet high, and the second story is built of brick to harmonize with the other plant buildings. The roof of the two-story part is of steel decking, and that of the single-story part is 4-inch reinforced concrete slab; both are insulated and covered with 4-ply pitch and gravel roofing. Floors are constructed of 4-inch concrete slabs having a ground corundum finish in the shower room, along aisles, and in front of lockers. Partitions are constructed of tile, and rooms are finished inside with cement plaster and painted twotones. The entire building is without windows.

The exterior doors in the upper story are wood; all doors inside the building are steel. The main entrance at street level is through two doors and down a concrete stairway to the change house. The other entrance or exit doors lead from the street-clothes and mine-clothes rooms to the outside or through the tunnel to the shaft.

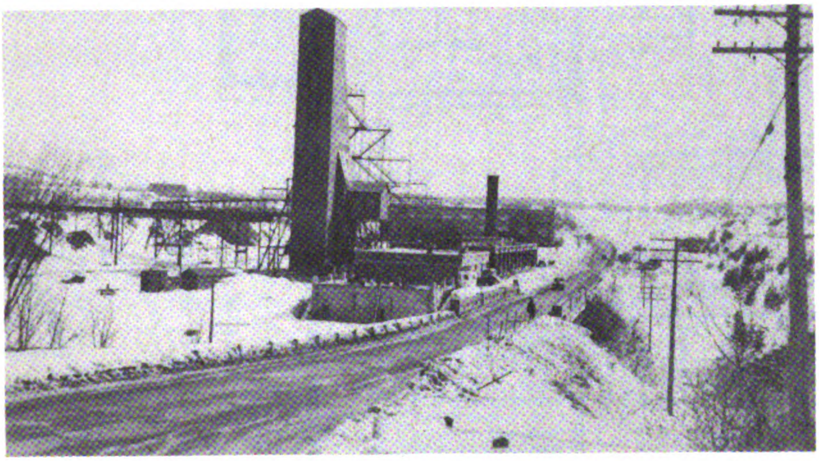

Figure I. - Mine A surface plant. Change house in foreground; shaft head frame in left center.

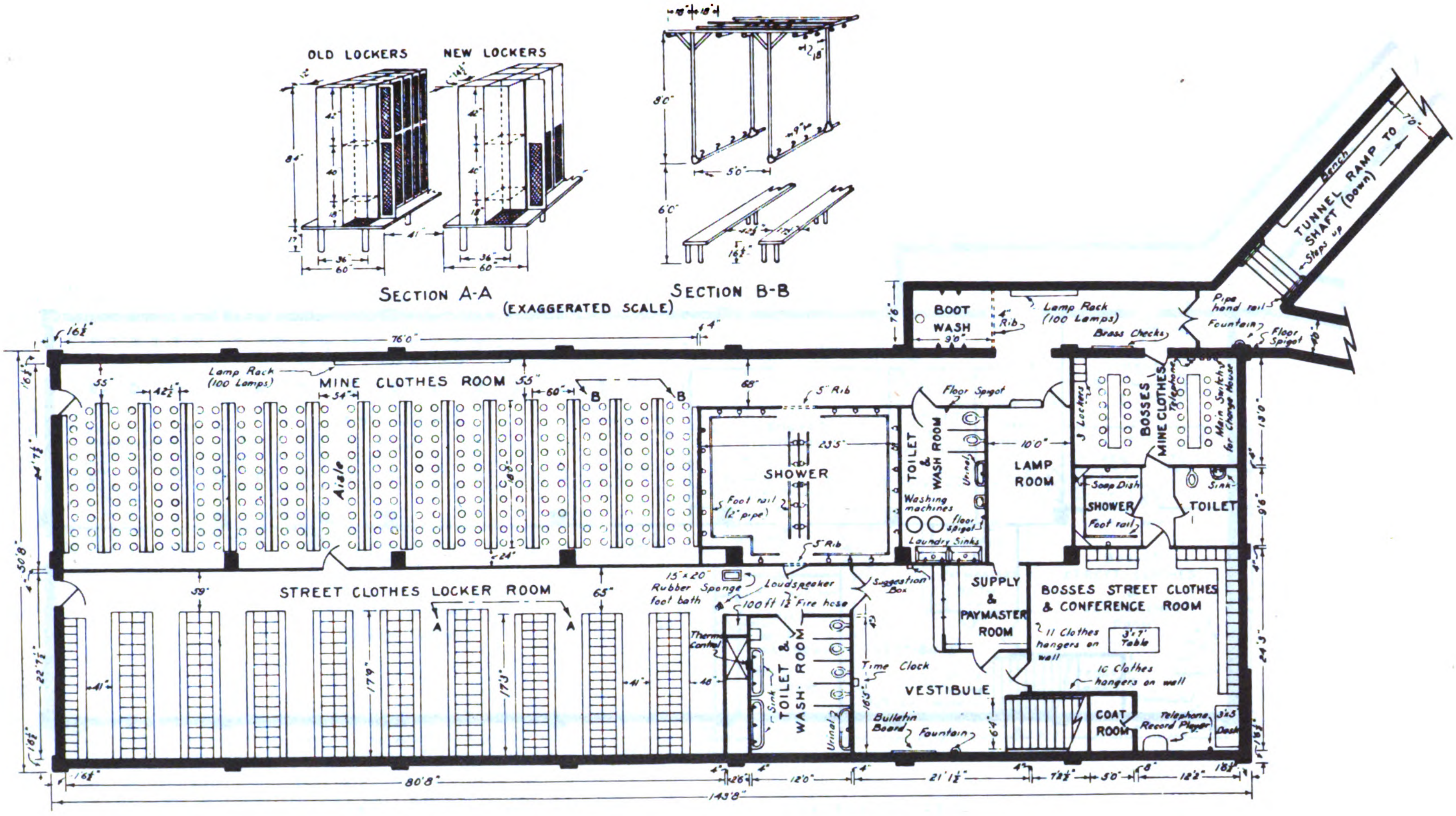

Figure 2. - Mine A change house, floor plan.

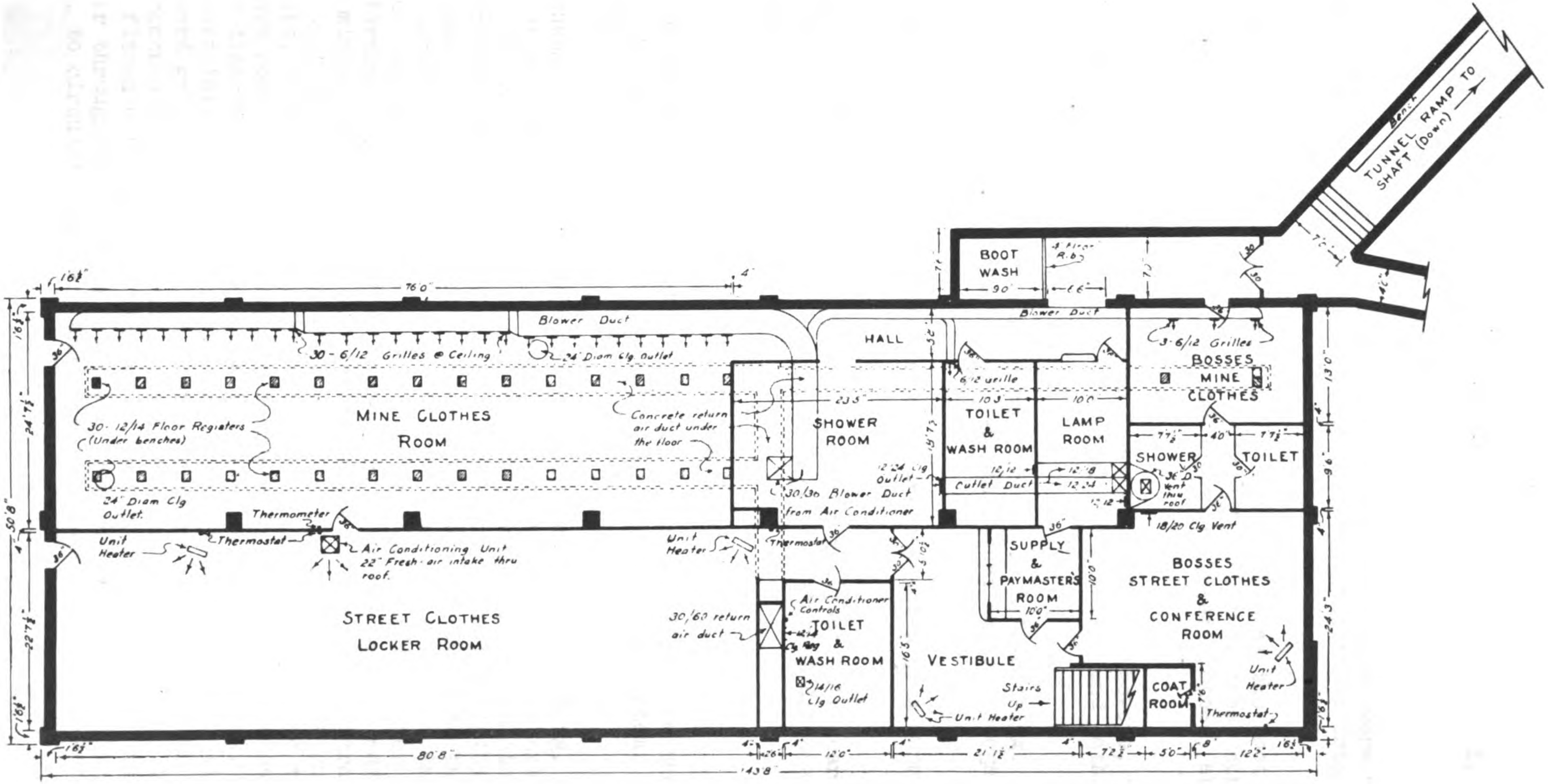

Figure 3. - Mine A change house, ventilation plan.

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Interior Arrangement

The floor plan is shown in figure 2; a few minor changes were made during or since erection. The change house is divided longitudinally into the street-clothes and mine-clothes sections.

The street-clothes section consists of a vestibule at the foot of the entrance stairway and rooms for the supervisors' street clothes, conferences, supplies, paymaster's office, lockers for miners' street clothes, and toilet facilities.

The mine-clothes section has rooms for mine clothes, showers, toilets, and laundry facilities, maintenance of lamps, and changing and bathing facilities for supervisors.

The door between the two large clothes rooms is self-closing. Access to the street-clothes section from the mine-clothes section is through the shower room.

The change house and the shaft cageway are connected by a tunnel lined with reinforced concrete.

Two drinking fountains are provided, one in the vestibule near the foot of the stairway and the other in the tunnel. A salt-tablet dispenser is at the drinking fountain in the tunnel.

Ventilation and Heating

This change house is one of the first, if not the first, in the Lake Superior district to incorporate a modern air-conditioning system. The general plan of ventilation is shown in figure 3.

The change house has two systems for ventilation and heating. The street-clothes section has individual, thermostat-controlled, unit heaters mounted near the ceilings in each room, with one unit ventilator in the street-clothes locker room connected through the roof to the outside to permit the introduction of fresh air. The unit heaters serve to heat and circulate the air. In summer the steam-heat supply is shut off from the unit connected through the roof to the outside. The thermostat controlling this unit is then reversed, thereby starting the fan when the temperature is increasing instead of decreasing. The mine-clothes section is ventilated and heated by a central air-conditioning unit in the warehouse. This unit supplies about 9,000 cubic feet of air a minute, of which 8,000 cubic feet a minute is directed into the large mine-clothes room, causing a complete change of air every 3 minutes; the remainder is distributed in other rooms in the mine-clothes section. The air is introduced into the rooms from blower ducts at ceiling height with uniformly spaced grilles - 28 grilles in the large mine-clothes room, 3 grilles in the foremen's mine-clothes room, and 1 each in the laundry and lamp rooms. Ducts are fitted with splitter dampers at each grille to control the distribution of air throughout the room. The air from the grilles is directed across each room, to circulate downward and enter concrete return-air ducts beneath

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the floor through register openings under benches. The return air passes through a riser in the wall between the street-clothes locker room and the adjacent toilet room to a mixing chamber, where fresh air is added. The mixture passes through a bank of dust filters and a steam radiator-coil heater and then is forced by the fan back into the blower ducts and recirculated. Concrete floor ducts incline toward the drains, permitting flushing out of dust accumulations once a month. Air is exhausted from the shower, laundry, and lamp rooms through roof gravity ventilators.

The temperature in the street-clothes section is maintained at 75° F. by individual unit-heater thermostats. The temperature in the mine-clothes section is maintained normally at 85° F. by a thermostat placed in the return-air duct riser. The thermostat control box is installed in the street-clothes section toilet and washroom and, in addition to the thermostat controls, includes a humidistat that regulates the mixture of fresh air introduced into the system when the humidity rises in the return air. During the summer months, when the outside humidity is high, the temperature in the mine-clothes section is raised to as high as 100° F., when not occupied by miners to provide adequate drying. Such high temperature is reduced when men come on or off shift.

The air-conditioning unit fan is driven by a 220-volt, 3-phase, 3-horsepower electric motor and delivers 9,420 cubic feet of air a minute. The main control switch is in the supply and paymaster's room. The steam is piped to the building from a boiler in the basement of the shop building. Filter units are of the cleanable, oil-impregnated, baffle-impingement type, which are periodically replaced. The humidistat control originally incorporated a wet-bulb thermometer in the return-air duct. Accumulations of dust on the wet-bulb wick caused discrepancies that led to replacing it with a hygroscopic-type that employs the elongation and contraction of certain hygroscopic materials as a functioning medium for humidity control.

Figure 4 is a sketch of the generalized schematic lay out of the air-conditioning unit together with the essential features and controls. The typical operating sequence is given below:4/

Dry-Bulb Temperature Control

The dry-bulb temperature of the change house is controlled by a dry-bulb thermostat in the recirculated-air duct, operating through a modulating-type face and bypass damper. Operation of the damper is such that as more heat is required in the room, the face damper opens wider, allowing more air to pass through the steam heating coil. Unduly chilled air is prevented from entering the rooms by a low-temperature control thermostat (dry-bulb limit thermostat) in the discharge duct. This thermostat functions to prevent the discharge air from going below a predetermined setting, which is normally 70° F., or 1 to 5 degrees below the desired room temperature.

4/ E. Orrick, ventilation engineer, Walker Jamar Co., Duluth, Minn.

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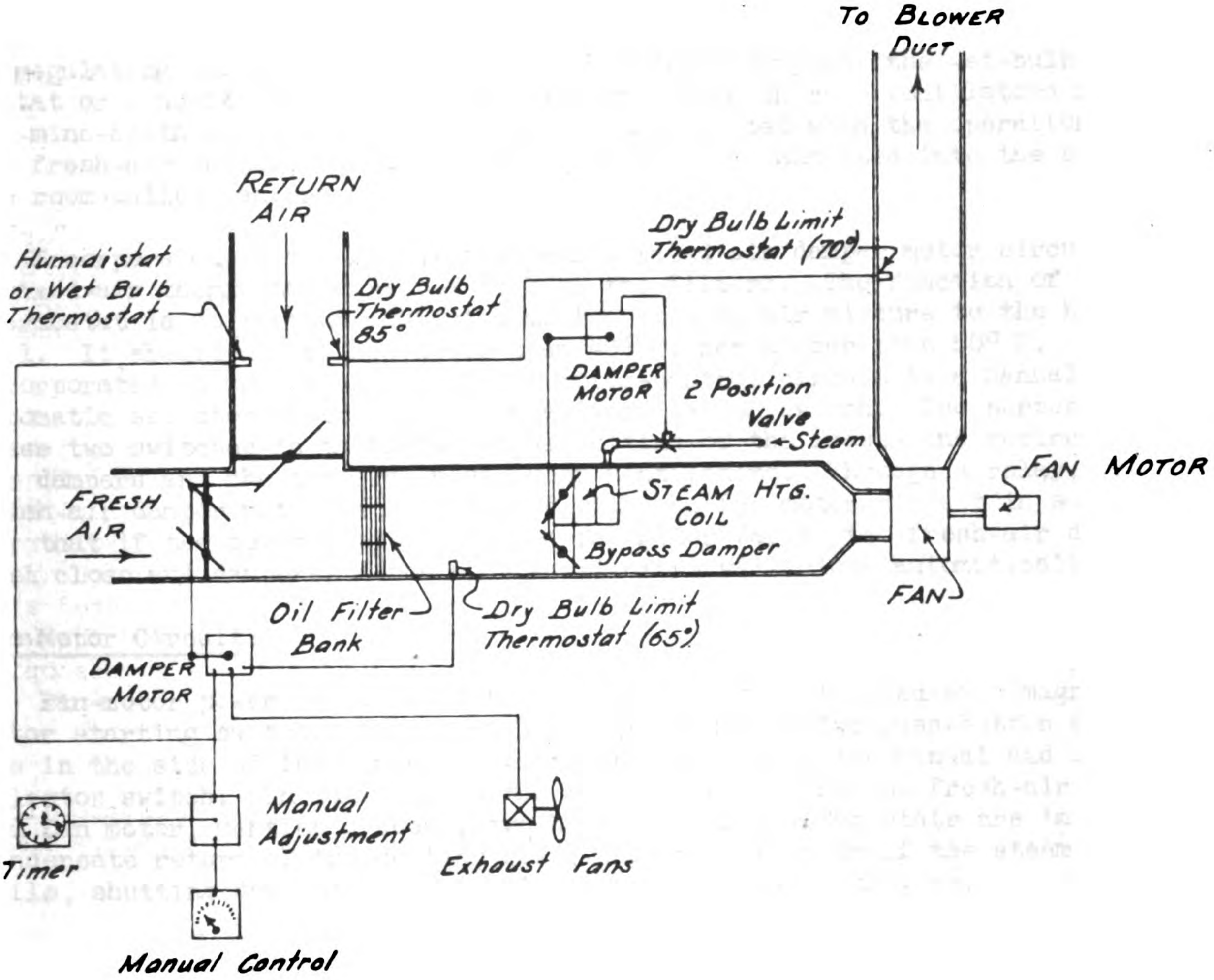

Figure 4. - Mine A change house, schematic sketch of air-conditioning unit.

Wet-Bulb Temperature Control:

The room wet-bulb temperature is controlled by a wet-bulb thermostat or a humidistat in the recirculated-air duct of the units. This control operates through a modulating-type damper motor, regulating the fresh-air and recirculated air dampers. Its action is such that upon an increase of humidity in the recirculated air, the fresh-air damper will open to admit more fresh air into the system to dilute the moist air to a satisfactory point. In addition to regulating the fresh-air and recirculated-air dampers, the wet-bulb thermostat or a humidistat controls the damper motors on roof ventilators from the mine-clothes room. Their action is synchronized with the operation of the fresh-air damper, so that as more fresh air is admitted into the system the room-outlet dampers open wider.

Incorporated in the fresh- and recirculated-air damper motor circuit is a mixed-air thermostat directly back of the filters. The function of this thermostat is to prevent admission of too cold an air mixture to the heating coil. It should not be set lower than 40° F. nor higher than 60° F. Also incorporated in the fresh-air damper motor-control circuit is a manual and automatic selector switch and a manual ventilation switch. The purpose of these two switches is to allow manual setting of the fresh- and recirculated-air dampers and the dampers in the roof ventilators. Through a relay, the fresh-air damper motor is interlocked with the fan motor circuit in such a way that if the power supplied to the fan motor fails, the fresh-air damper will close and dampers in the roof ventilators will close automatically.

Fan Motor Circuit:

Fan-motor power is supplied through a circuit controlled by a magnetic-motor starting switch. This switch is equipped with two push-button stations, one in the side of the control box and the other near the manual and automatic selector switch. In addition to the relay interlocking the fresh-air damper and fan motor, mentioned above, two heat-exchanger thermostats are in the condensate return of the heating coil; they will operate if the steam supply fails, shutting down the fan and closing the fresh-air dampers.

Gravity Ventilator

In addition to the roof ventilators mentioned above in connection with humidity control, other gravity roof ventilators are connected to the toilet and shower rooms. A manually operated valve is in the grille in each of these rooms to control the amount of air being vented from a particular room. In addition to these manually operated dampers, a manually operated damper is in the roof ventilator.

The above operating sequence and the schematic sketch apply to all ventilation and air-conditioning plants in the mine change-house installations described, with the exception of change house D. To avoid repetition, only variations will be discussed in the remaining descriptions.

Lighting

The change house is illuminated by 100- and 200-watt, 110-volt, incandescent light bulbs equipped with floodlight-type reflectors. Silver-bowl type bulbs are in the lamp, supply, and conference rooms.

The large rooms have two lighting circuits, one for aisle lights and the other for general room illumination. Aisle lights are spaced 14 feet apart. The street-clothes room has two bulbs 14 feet apart between each row of lockers. The mine-clothes room has a central ceiling light between each row of benches and a floodlight mounted 8 feet high on each wall at the end of each row.

All wiring is in metal conduit leading to a main switch-control box in the supply room. The control box contains individual room circuit switches of a reset relay-type for overload protection. Aisle lighting is controlled by toggle switches at room-door entrances. The main power-disconnect switch is in the supervisors' mine-clothes room.

Mine-Clothes Facilities

The mine-clothes room is provided with 267 chain clothes hangers on 16 overhead racks, as shown in figure 5. The clothes are suspended near the ceiling on hooks attached to an endless chain passing through a pulley attached to a rack. The chains are equipped with rings that permit the locking of hooks after they are pulled up; this suspends the hooks 12 feet above the floor. Each man is supplied with two identical combination padlocks, one for the mine-clothes chain and the other for the street-clothes locker. The suspension structure for the chains is constructed of 1-1/2-inch pipe and angle iron hung from the ceiling; the hanger straps are set in the concrete roof slab at the time of pouring.

Wooden benches on 5-foot centers are mounted directly under each hanger rack. The benches are constructed of three 2- by 6-inch planks on 2-inch pipe and iron frames set in the concrete floor.

A lamp rack is mounted on the wall by the main aisle of the mine-clothes room for storing charged electric cap lamps ; this arrangement avoids congestion at the lamp-room window during shift changes. Another lamp rack, in which lamps are deposited by the off-going shift, is mounted on the tunnel wall near the boot wash.

The tunnel connecting the change house and shaft is extended a few feet beyond the entrance to the mine-clothes room hallway, providing an extension that serves as a boot-washing station. It has a 5-inch concrete curbing and is equipped with four short lengths of hose connected to the water supply (fig. 6).

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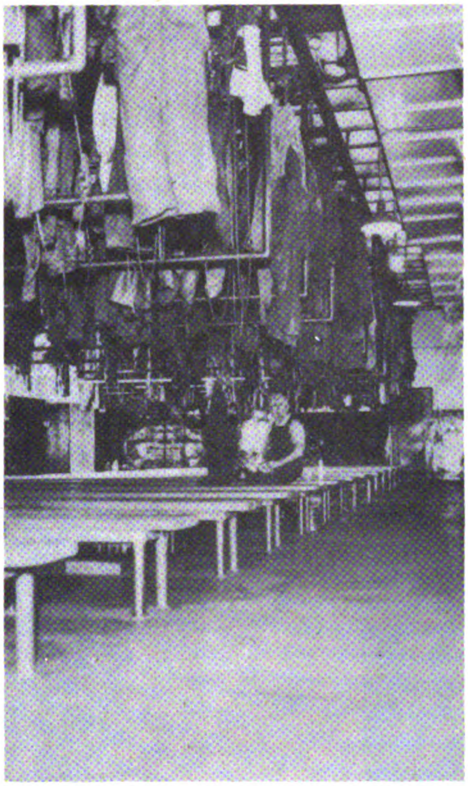

Figure 5. - Mine A change house, mine-clothes room.

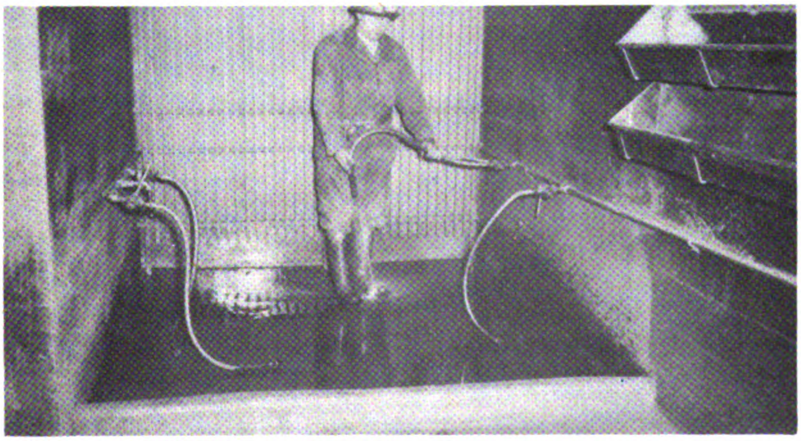

Figure 6. - Mine A change house, boot wash.

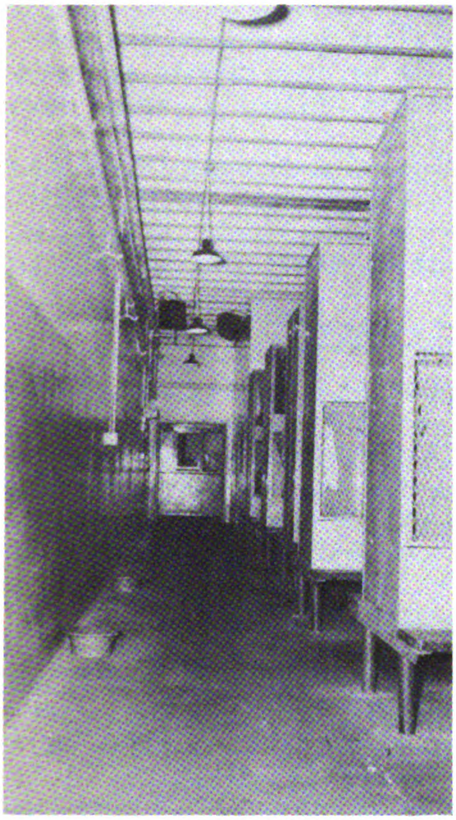

Figure 7. - Mine A change house, street clothes room.

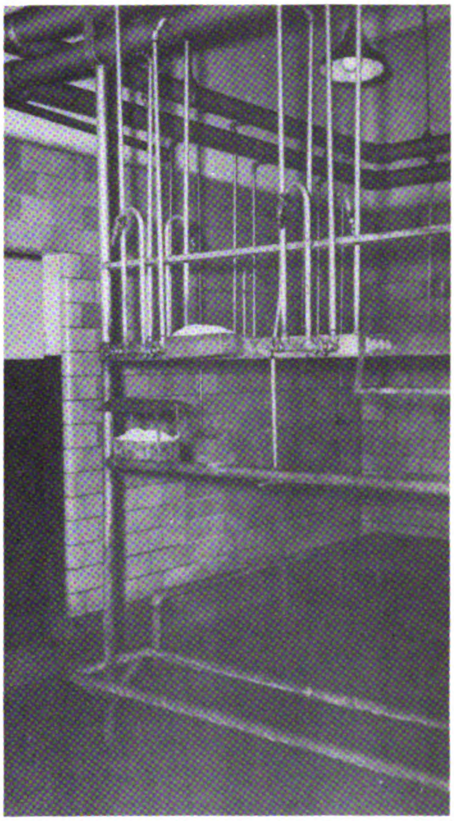

Figure 8. - Mine A change house, shower room.

Rooms for Mine Officials

Mine officials are provided with a shower, toilet, mine-clothes room, and street-clothes change room, which is also used as an office and conference room.

The street-clothes room contains 24 clothes lockers with benches, desk, large conference table and chairs, telephone, and public-address system connected to loudspeakers in the street-clothes and mine-clothes change rooms for the employees. The public-address system can broadcast music as well as announcements.

A combined shower and toilet room, separated by a metal partition screen, is between the street-clothes and the mine-clothes rooms. It is equipped with two shower heads, a toilet, and a porcelain wash basin.

The mine-clothes room is equipped with two benches and clothes racks similar to those in the larger mine-clothes room for employees; it also contains 22 chain hangers, three lockers, mine telephone, and three switch boxes controlling the electric power to the building.

Street-Clothes Facilities

The street-clothes room is equipped with 287 lockers arranged in 10 rows on 8-foot 5-inch centers. Two types of lockers are used; one type has a completely screened front, and the other, which is slightly larger, has the lower half screened. The lockers are mounted back to back on a pipe- and angle-iron framework permanently set in the concrete floor (fig. 7). Attached to the frame of each row of lockers are 2- by 12-inch plank benches.

Bathing Facilities

The shower room has a 9-foot wainscoting of glazed tile and a 5-inch curbing at each doorway. The room contains 33 shower heads; 23 of them are spaced around the walls and 10 are mounted on a pipe-rack stand in the center of the room (fig. 8). The heads are of the ball-socket, jet-spray type mounted 7 feet above the floor and are supplied through 1/2-inch piping from 4-inch hot- and cold-water manifold pipes around the walls near the ceiling. Each shower has hot- and cold-water mixing valves. Hot water is obtained from three 500-gallon tanks in the boiler room through a master mixing valve regulating the temperature at 120° F. A foot railing of 2-inch pipe is provided under the shower heads 15 inches above the floor and 12 inches from the wall. Provisions are made for the use of solid and liquid soap: the latter is piped from a 50-gallon tank in the garage overhead.

Other accessories to the bathing facilities are a sponge-rubber foot bath, clean towels three times a week, and adequate floor drainage.

Toilet Facilities

The toilet and wash room in the street-clothes section is equipped with four porcelain toilet stools in open metal booths, a 5-foot, horizontal, porcelain urinal trough, two 6-foot, porcelain wash basins with three sprinkler-type heads, and a large waste receptacle.

The toilet room in the mine-clothes section is provided with two porcelain toilet stools, a 3-foot, horizontal, porcelain urinal trough, a small porcelain sink, and laundry facilities, including two electric washing machines, and two double laundry sinks. Paper towels are supplied in both clothes rooms, and refuse cans are provided for their disposal.

All toilets are flushed manually, and urinals are flushed automatically at intervals.

General Sanitation

The surface boss at the mine supervises the maintenance and upkeep of the change house. An attendant for each shift is employed in the change house, and a lamp-room attendant is employed on the day shift. The attendants, other than lamp attendant, are elderly men, former miners, and all have had first-aid training.

The entire change-house floor area is washed after each change of shift. Benches are washed, fountains, wash troughs, sinks, toilets, and urinals are scoured and disinfected, and foot-bath solutions are changed once a day. Bar deodorants are used in urinal troughs. The floors and walls of the shower rooms are washed thoroughly after each shift. Walls are cleaned twice a year. The waste receptacles are emptied once each shift.

When concrete floors in the shower rooms become slippery from imbedded deposits of soap and slime or become unduly colored from iron-ore stain, they are cleaned and etched with a hydrochloric-acid solution and then thoroughly washed with water to remove the acid. The etching removes imbedded deposits of soap and exposes corundum particles in the concrete floor, thereby greatly reducing the slipping hazard.

The air-conditioned ventilation controls humidity and room temperatures, airs and dries clothes, removes dust, and removes undesirable air from toilet rooms, showers, and the lamp room.

Miners can travel between the shaft and change house without exposure to outside weather conditions.

Fire Prevention and Control

Heat is piped to the building from a separate heating plant, and exposed piping is hung near the ceilings away from clothing.

In addition to the hose used for washing the floors, a 100-foot reel of 1-1/2-inch fire hose is stored in a recess in the hallway of the street-clothes room. Convenient water-pipe connections are provided in both the street-clothes and the mine-clothes sections.

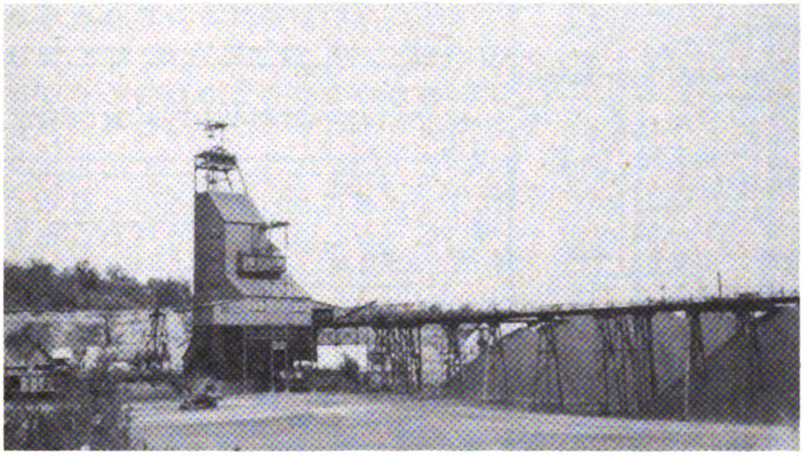

Figure 9. - Mine B surface plant.

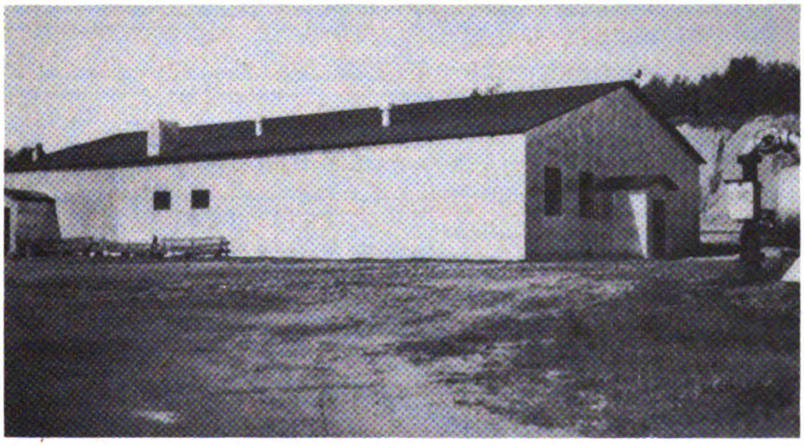

Figure 10. - Mine B change house, exterior view.

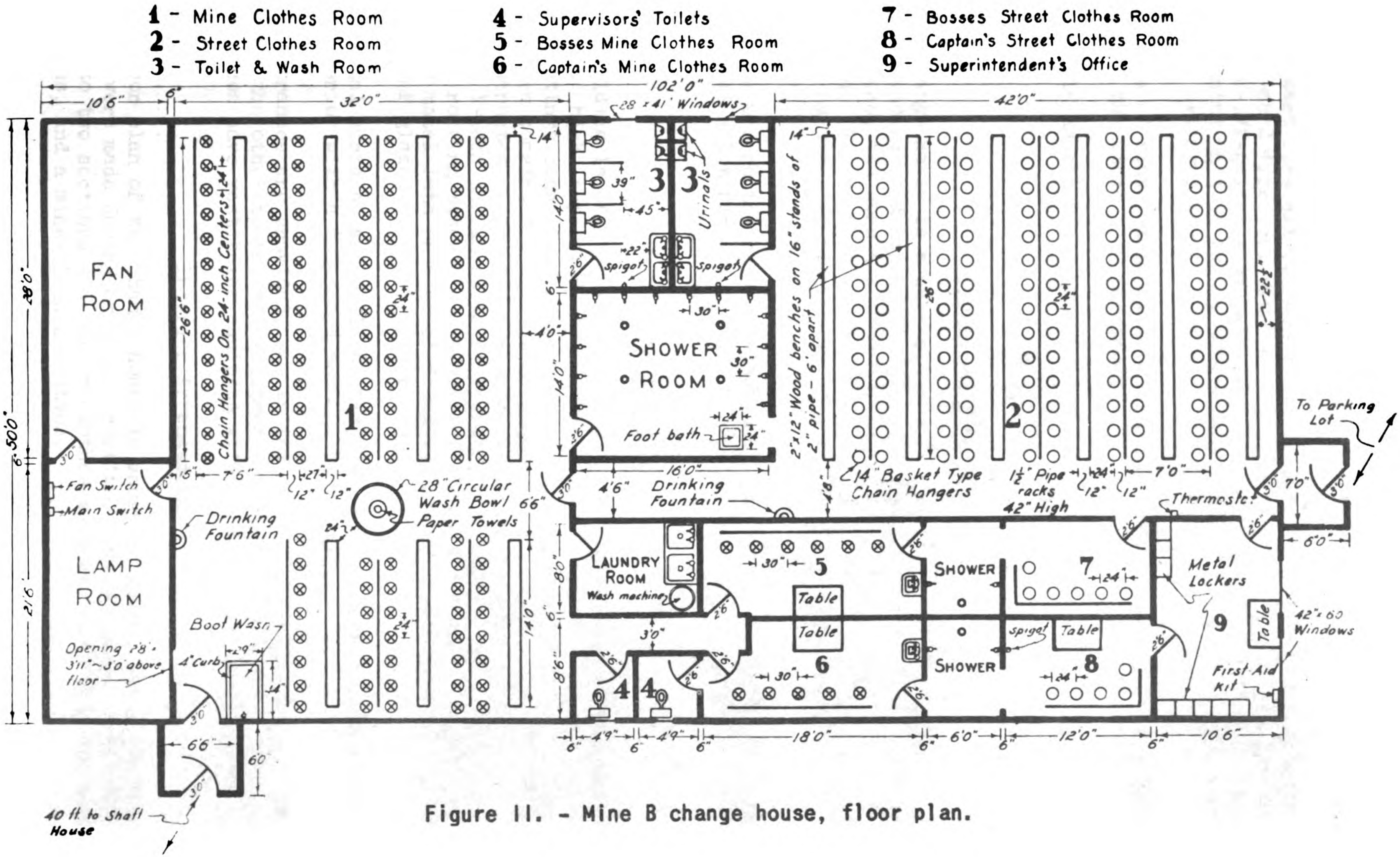

Figure 11. - Mine B change house, floor plan.

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Two 1-quart fire extinguishers, one a carbon tetrachloride-type and the other a soda-acid type, are provided near the tunnel entrance to the change house. Two 2-1/2-gallon soda-acid type fire extinguishers are kept near the air-conditioning unit in the warehouse section of the second floor. Another 2-1/2-gallon extinguisher is kept in the garage section of the second floor.

Two sets of ventilation doors are in the tunnel, one at the change-house entrance and the other near the shaft.

The building has four exits.

MINE B

General Information

This change house is a separate building designed to accommodate 140 surface and underground employees. It was constructed in 1940, replacing an older structure, and consists of a one-story metal building 50 feet wide and 102 feet long. Figure 9 shows the shaft head frame in the foreground; the change house is directly behind it. Figure 10 is an exterior view of the change house.

The area around the structure has been graded and surfaced with broken rock. A parking lot for the use of employees is provided adjacent to the building.

Construction

The building is of steel-framework construction having sheet-metal walls 12-1/2 feet high separated by fiber-board insulation 1-1/2 inches thick. The wall footings consist of concrete extended 6 inches above the ground. The floors are constructed of 4-inch reinforced concrete slab. The gabled roof is constructed of pressed standing-seam metal roofing covered with building paper, a 1-inch thickness of fiber-board insulation, and several layers of tar-paper roofing material. Partitions are constructed of smooth-finish plaster over metal lath on a steel framework. Toilet and shower rooms have a wainscoting of glazed tile 7-1/2 feet high.

All metal surfaces are well painted, the exterior with an aluminum paint and the interior with a two-toned red and buff color.

Two entrances are provided, one to the street-clothes side near the parking lot and the other to the mine-clothes side within 50 feet of the shaft. Both entrances have vestibules equipped with wooden doors, which swing inward.

Interior Arrangement

The floor plan of the change house is shown in figure 11; a few minor alterations were made during or since erection. The building is divided, roughly, into two sections - a street-clothes section, including the supervisors' rooms, and a mine-clothes section.

The street-clothes section has an outside entrance and rooms for the following: street clothes, toilet and washing, office, and changing facilities for mine supervisors. The captain and superintendent share quarters separate from shift bosses.

The mine-clothes section has rooms for the following: mine clothes, toilet and washing, showers, laundry, electric lamps, and air-conditioning unit serving the building.

A self-closing door, without a handle on the mine-clothes room side, is provided for traffic from the street-clothes to the mine-clothes room. Access to the street clothes section from the mine-clothes section is through the shower room.

Two drinking fountains are provided; one is in the street clothes room near the shower, and the other is in the mine-clothes room near the lamp-room window.

Ventilation and Heating

A plan of the change-house ventilation and heating system is shown in figure 12. The building is ventilated and heated by means of an air-conditioning unit in the fan room. Fresh air is mixed with recirculated air from floor ducts; then the mixed air is filtered, heated, and forced under pressure into blower ducts at ceiling height for distribution throughout the building. A part of the air passes to the outside through roof vents in the shower, toilet, mine-clothes, and lamp rooms. The remaining air is drawn through floor registers under the benches and returns to the blower for filtering and recirculation.

Two vertical exhaust ducts suspended 12 inches above the floor are in two corners of the mine-clothes room and discharge through 30-inch square louvres on the roof. Each duct is equipped with an exhaust fan powered by a 1/3-horsepower electric motor. Each fan has a capacity of 4,000 cubic feet of air a minute and exhausts dust-contaminated air from the mine-clothes room; each is electrically controlled by a timing device in the lamp room and operates during shift changes.

The main air-conditioning unit delivers 13,480 cubic feet of air a minute to the change house, of which 7,260 cubic feet a minute is delivered to the mine-clothes room, 3,270 cubic feet a minute to the street-clothes room, and the remainder to the various other rooms. The mine-clothes room is provided with a complete change of air every 5 minutes. The air-conditioning unit fan is powered with a 3-horsepower, 220-volt, 3-phase electric motor. The maximum heating requirement of the steam coils is approximately 1,590,000 B.t.u. an hour for a 70° F. rise in temperature of heated air.

The thermostat control, normally set at 80° F., is in the street-clothes room near the office entrance. Inasmuch as the change of air is more rapid in the mine-clothes room, its temperature is about 5 degrees higher than that in the street-clothes section.

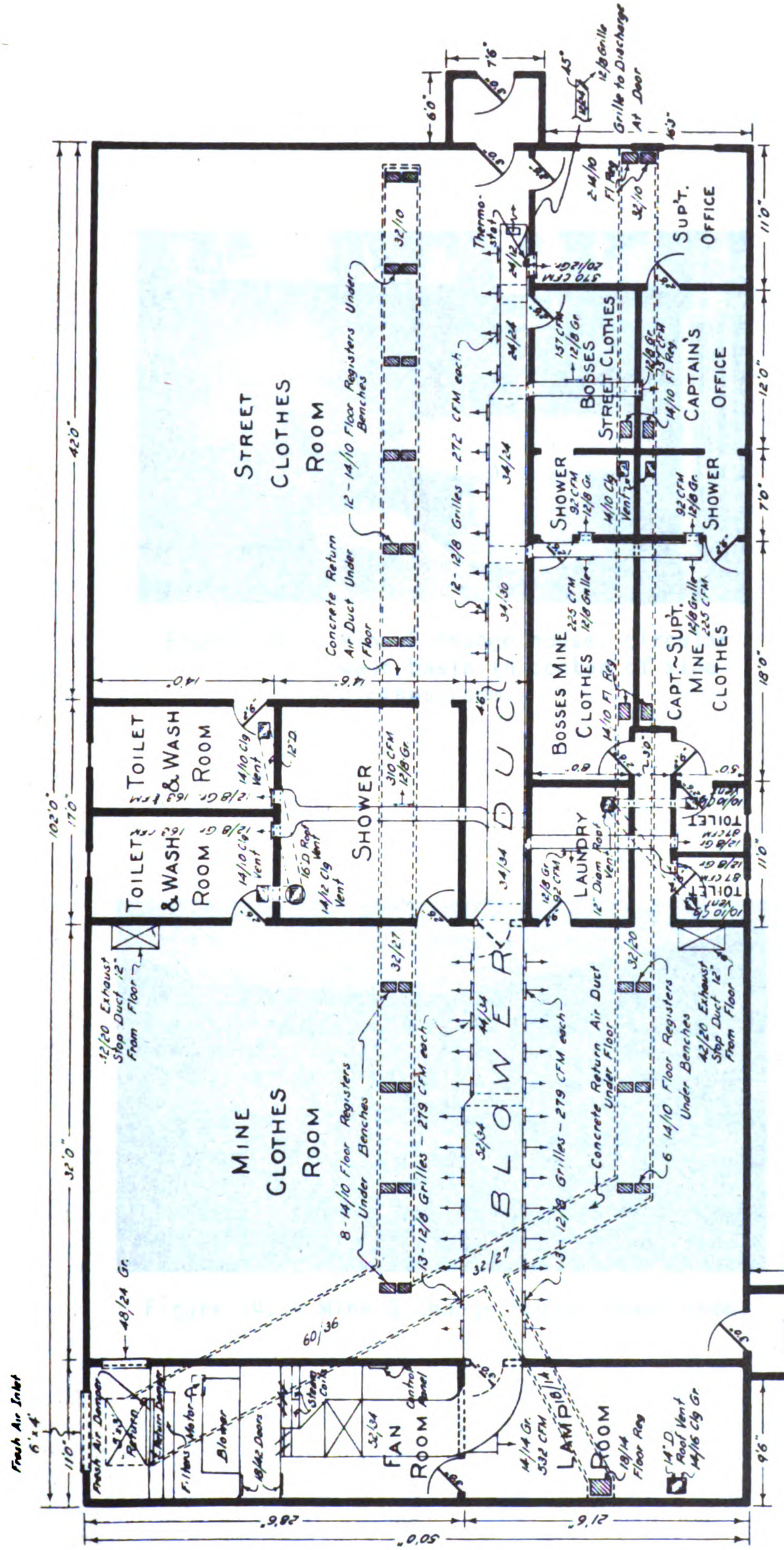

Figure 12. - Mine B change house, ventilation plan.

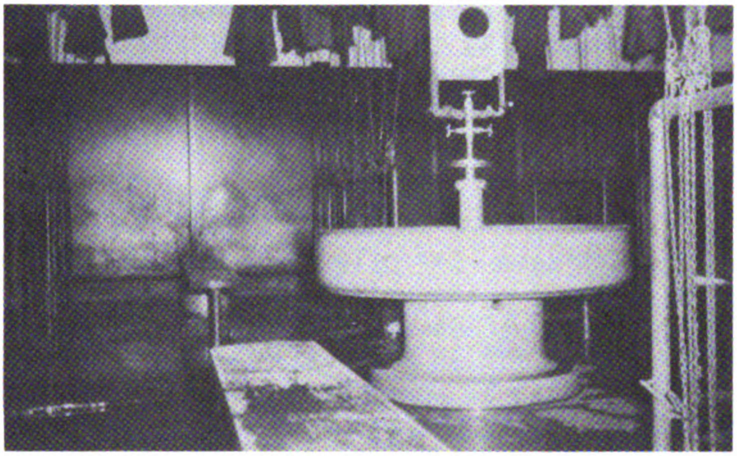

Figure 13. - Mine B change house, circular wash basin in center of mine-clothes room.

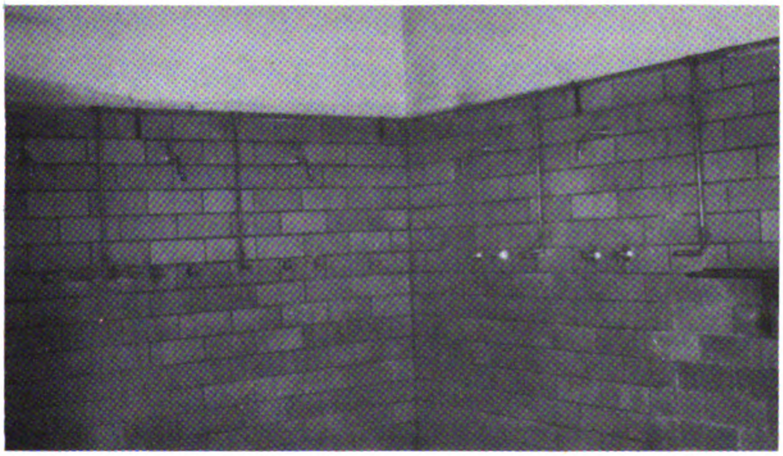

Figure 14. - Mine B change house shower room.

The change house is heated by steam from the heating plant.

Lighting

The change house is illuminated by 100-watt, 120-volt incandescent light bulbs with floodlight reflectors hung 12 feet above the floors. The large rooms have lights on 10-foot centers in rows above benches and aisles. All light switches are of a toggle type mounted at uniform height on walls near the entrances to the various rooms. The main switch in the lamp room is protected against overloads or short circuits by low-melting fuse links. All wiring is in metal conduit.

Mine-Clothes Facilities

The mine-clothes room is equipped with 136 hook- and basket-type chain clothes hangers suspended from ceiling pulleys and anchored on pipe hanger stands in rows 7-1/2 feet apart. The stands are permanently set in the concrete floor, and the rows are separated by a central aisle. The clothes are suspended 10-1/2 feet above the floor by means of a single chain anchored to the hanger on one end, strung through a ceiling pulley, and hooked over the pipe rack by a hook and eye fastened to the chain. The other end of the chain is anchored to the rack to hold the hanger about 4 feet above the floor when the chain is extended. Wooden benches of 2- by 12-inch plank mounted on 2-inch pipe stands 15 inches high, are between hanger stands. Surface employees use one side of the room, and miners use the other side. A circular wash basin (fig. 13), is centrally located in the aisle and is equipped with liquid-soap and paper-towel dispensers.

A concrete basin with a 4-inch curbing, sheet-metal splash boards, and faucet water connections, is provided near the outer entrance for washing mine boots. Boot jacks are mounted on the pipe-hanger stands to aid miners in removing their boots.

Underground employees receive and deposit their lamps at the lamp-room window.

Rooms for Mine Officials

The mine officials' rooms are divided into two sections - one with facilities for five men serving the captain and superintendent, and the other serving six shift bosses. Both sections have a small street-clothes room equipped with chain clothes hangers, a shower room with two heads, and a mine-clothes room equipped with chain hangers, a porcelain wash basin, paper-towel dispenser, and a table. The office adjacent to the captain and superintendent's street-clothes room has eight clothes lockers, benches, table, and first-aid cabinet. Each section is provided with a small room containing a single porcelain toilet.

Street-Clothes Facilities

The street-clothes room is equipped with 140 chain hangers similar to those used in the mine-clothes room, suspended from ceiling pulleys and anchored to five pipe hanger stands. The pipe hanger stand rows are 7 feet apart, and 14 chain hangers are on each side of each stand.

Wooden benches of 2- by 12-inch plank mounted on 2-inch pipe stands 15 inches high are between hanger stands.

Bathing Facilities

The shower room is provided with a door at the mine-clothes room entrance to minimize the spread of dust and grime into the room. The room contains 14 ball-socket, jet-spray-type shower heads mounted 6-1/2 feet above the floor on three sides of the room. Hot water is piped to the building from the engine house and is stored in a 850-gallon tank on the ceiling joists of the lamp room. The water temperature for individual showers is controlled by hot and cold water mixing valves, and provisions are made for the use of liquid and solid soap (fig. 14). Soap solution is mixed by the change-house attendant in a 50-gallon drum mounted on ceiling joists over the shower room and is piped to the shower room, toilet-room wash basins, and the large circular wash bowl in the mine-clothes room. A 24-inch-square rubber foot bath is kept near the street-clothes room entrance and is cleaned and refilled daily. Adequate drainage is provided in all rooms for washing floors.

The laundry room is equipped with a double laundry sink and an electric washing machine.

Toilet Facilities

Both the mine-clothes and the street-clothes sections have separate toilet facilities in similar rooms, each equipped with three single-stool porcelain-bowl toilets in open metal booths, two single-type upright porcelain urinals, and two porcelain wash basins with paper-towel dispensers. The toilets and urinals are flushed manually, and bar deodorants are kept in the urinals.

General Sanitation

The surface boss at the mine supervises the maintenance and upkeep of the change house. One attendant is employed for each shift; he also maintains the miners lamps and serves as watchman.

The entire change-house floor area is cleaned and washed after each shift change. Floors, benches, toilet booths, and urinals also are washed. Wash bowls, sinks, fountains, and toilets are scoured, and footbath solution is changed daily. Special effort is made to remove soap from shower-room floors and to keep liquid-soap dispensers in working order. Toilet bowls, seats, fountains, and wash basins are disinfected with Lysol solution once a week. Adequate waste cans are conveniently placed and are emptied once a shift.

The air-conditioning ventilation unit controls humidity and room temperatures, airs and dries clothes, removes dust, and removes undesirable air from toilet rooms, showers, and the lamp room.

Fire Prevention and Control

Steam for heating is piped to the building from a separate heating plant, and exposed piping is hung near the ceilings away from clothing and combustibles.

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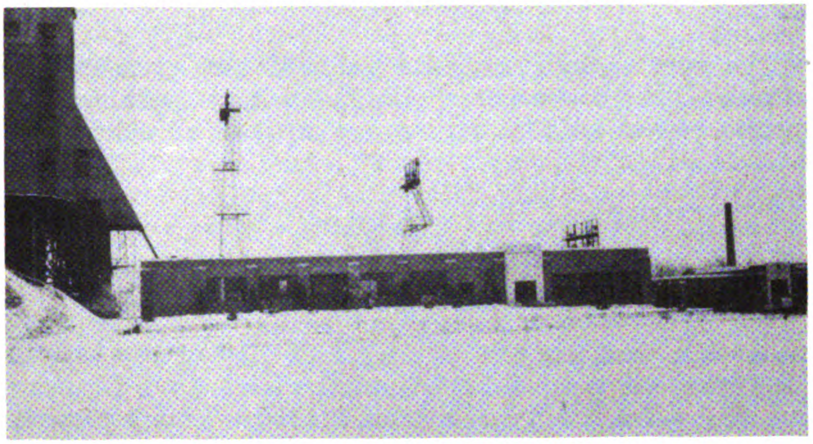

Figure 15. - Mine C, surface plant.

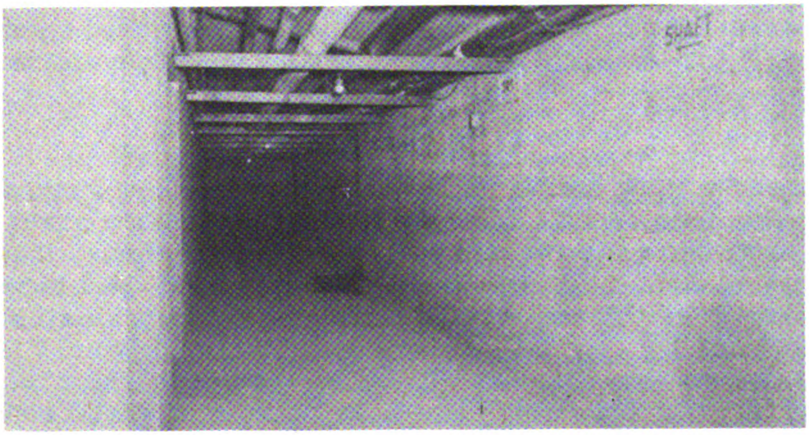

Figure 16. - Mine C change house, concrete tunnel to shaft cage landing.

All electric wiring is in conduit and is provided with adequate fuse overload protection.

Chain clothes hangers are equipped with low-melting-temperature links between the hangers and the chains. In event of fire to clothing, a link will part, allowing the clothing to drop to the floor and prevent spreading of fire to adjacent clothing.

Garden hose is kept in the laundry room, and water connections are provided throughout the building. In addition, a fire hose with sufficient length to serve the change house is maintained at the engine house nearby. The building has two exits.

MINE C

General Information

The change house, which was designed to accommodate 150 underground employees, was constructed in 1941 as an integral part of a new surface plant. It occupies the basement part of a steel and masonry building 186 feet 7 inches long by 45 feet 6 inches wide, housing the shops, garage, laboratory, and air-conditioning plant. The change rooms were designed for the basement to economize in construction and heating and also to have convenient access by tunnel to the shaft.

The surface structures shown in figure 15 consist of the shops and change-house building in the center, the office building at the right, with the engine house (not visible) behind, and the shaft head frame on the left. All are connected to the shaft cage landing by an L-shaped, underground, concrete-lined tunnel (fig. 16). A railroad spur track in front of the shops and office leads to the stockpile area. A parking lot and automobile shelter for the use of the employees is provided on the opposite side of the tracks, approximately 250 feet from the change-house entrance. The grounds around the structures and the roadways have been cleared, graded, and surfaced with broken rock and gravel.

Construction

The shop building is constructed of cinder block with a brick exterior and white-stone trim, steel window sash, and all metal doors and frames. The change house in the basement is 43 feet 6 inches wide by 141 feet 4 inches long, inside dimensions. Its walls are constructed of 12-inch reinforced concrete, lined with brown glazed tile. Partitions are 6 inches thick, constructed of glazed tile on plastered metal lath backed by a steel framework. The floors are of 5-inch reinforced concrete slabs. In the shower room and boot wash the floors are 4 inches lower than the main floors and have a non-slip trowel finish. The main rooms have plaster ceilings 13 feet high. Plumbing and wiring for the building are concealed in an accessible 3-foot space between the change-house ceiling and the shop floor.

Entrance to the change house is through a vestibule on the shop floor level and then down two flights of stairs. Exit to the shaft is through a hallway to the tunnel.

Interior Arrangement

Figure 17 shows the floor plan of the change house; a few minor alterations were made during or since erection. The change house is divided longitudinally into a street-clothes and a mine-clothes section.

The street-clothes section is entered through a pair of doors at the foot of the stairway. A combination toilet and wash room is at one end of the section, and a drying room is interposed between the showers and the street-clothes room at the other end of the section.

The mine-clothes section consists of rooms for the following: mine clothes, toilet and washing facilities, change house attendant, laundry, maintenance of lamps, washing mine boots, and changing facilities for mine supervisors.

The side door connecting the street-clothes and mine-clothes room opens toward the latter and normally is kept closed by spring action. No handle is provided on the mine-clothes side. A similar door connects the drying room and the street-clothes room to permit travel from the showers to the street-clothes room only.

Two drinking fountains are available; one is in the street-clothes room hallway, and the other is in the mine-clothes room hallway.

Ventilation and Heating

The arrangement of blower ducts, grille openings, registers, floor ducts, and gravity vents of the ventilation plan is shown in figure 18. The ventilation and heating of the change house is controlled through an air-conditioning unit in a room above the supervisors' street-clothes section. The unit serves the change-house portion of the building and the laboratory and surface employees change rooms on the shop-floor level. It supplies 8,047 cubic feet of air a minute to the change house, with 3,950 cubic feet a minute apportioned to the mine-clothes room, producing a change of air every 4 minutes; 1,560 cubic feet of air a minute to the street-clothes room; 480 cubic feet of air a minute to the shower room; and the remainder to the various smaller rooms. Except for the mine-clothes room, all the rooms are provided with six changes of air an hour.

The air enters at ceiling height through blower ducts and grille openings and leaves through registers under benches. The return air is mixed with fresh air, filtered, heated, and forced back into blower ducts, as with the air-conditioning units in the change house previously described; however, the blower duct branch leading to the mine-clothes section is provided with an extra steam-radiator heating coil having by-pass dampers regulated separately by a thermostat in the mine-clothes room. The main thermostat control for the plant is in the street-clothes room. By this means the difference in temperature between the street-clothes section and the mine-clothes section is maintained under positive control. The temperature is regulated between 70° F. and 75° F. in the street-clothes section and from 85° F. to 100° F. in the mine-clothes section.

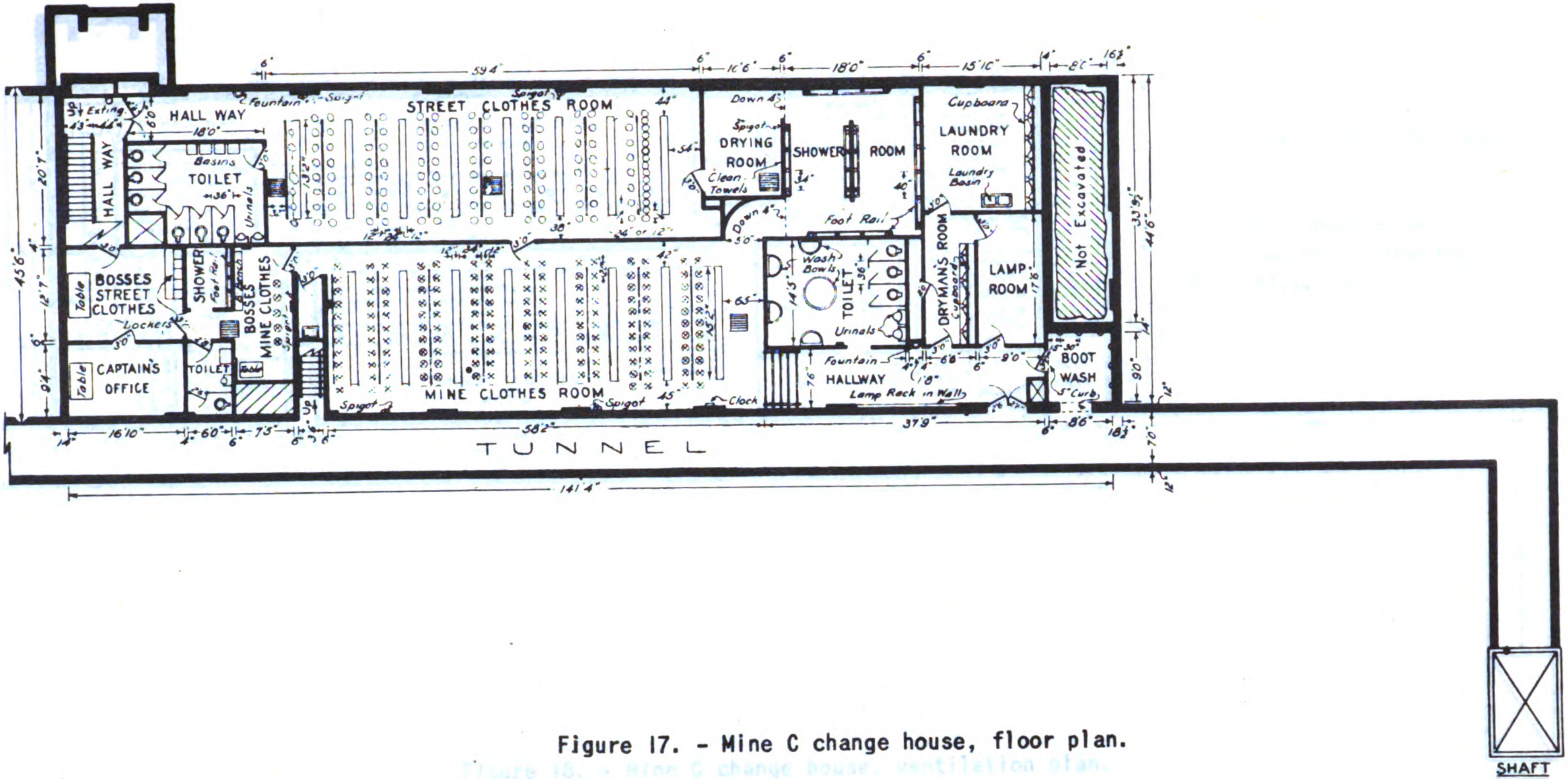

Figure 17. - Mine C change house, floor plan.

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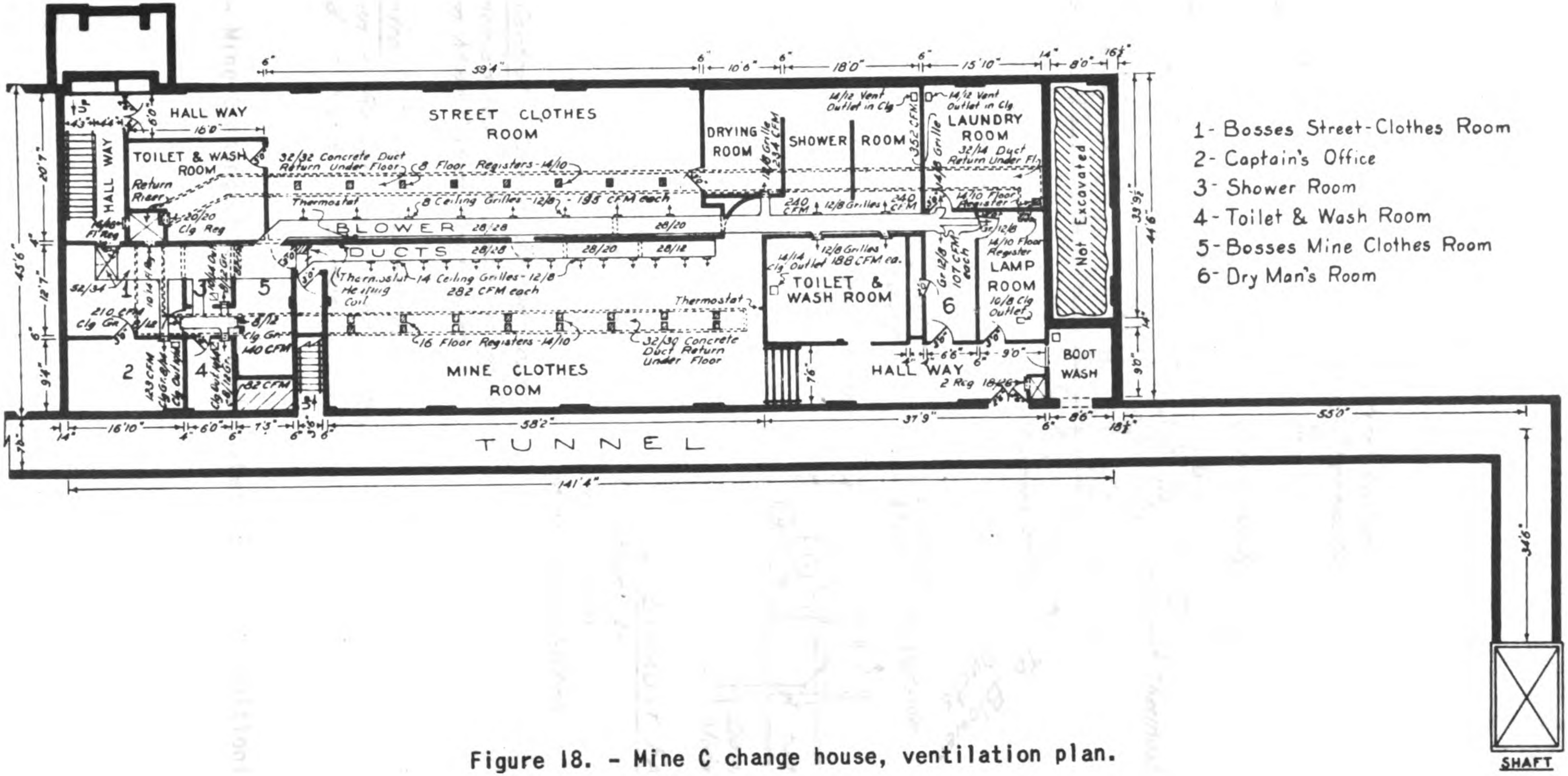

Figure 18. - Mine C change house, ventilation plan.

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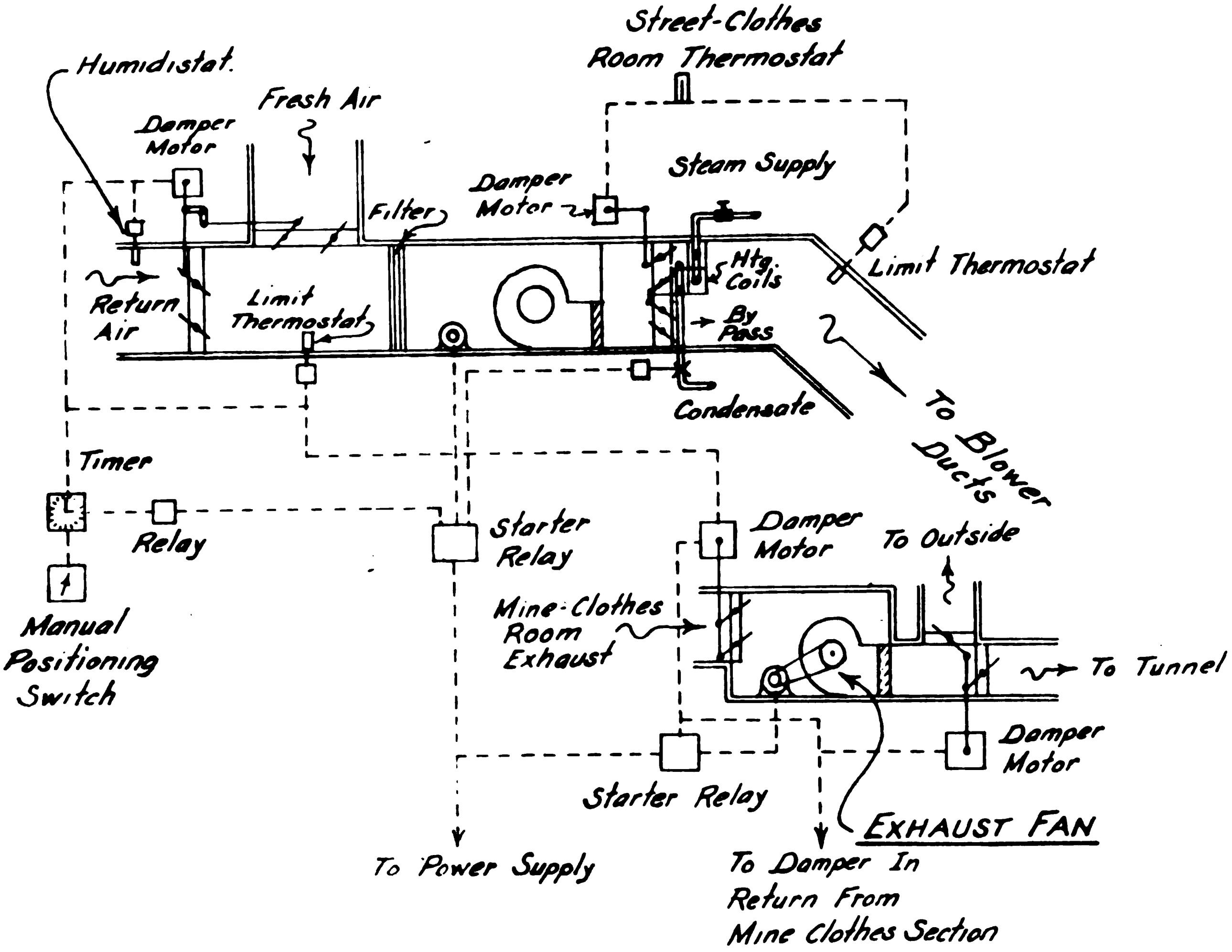

Automatic Control: Tunnel damper open — Exhaust synchronized with fresh air damper - Return from Mine Clothes Room open.

Manual Control: Tunnel damper closed — Exhaust open — Return from Mine-Clothes Room closed. — Fresh air damper positioned

Figure 19. - Mine C change house, schematic sketch of air-conditioning unit.

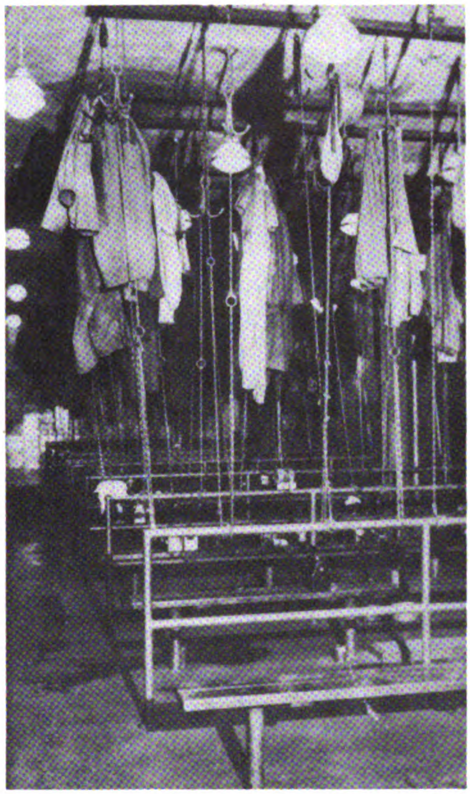

Figure 20. - Mine C change house, mine-clothes room.

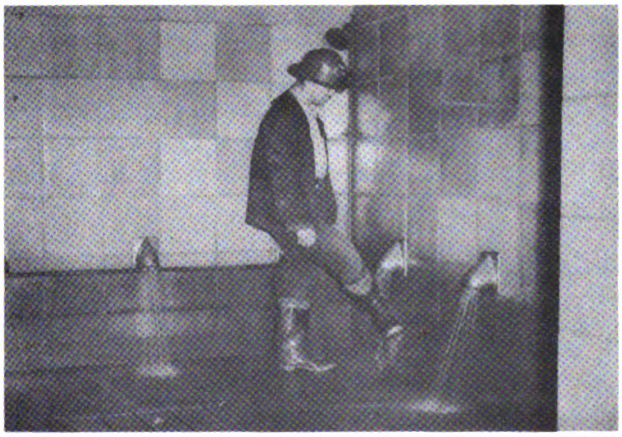

Figure 21. - Mine C change house, boot wash.

The exhausted air is regulated through a riser vent at the far end of the hallway off the mine-clothes room. An exhaust fan in the riser vent is regulated to coincide with the fresh-air damper control. A schematic sketch, figure 19, shows the general operation of the ventilating system. Ordinarily, the air is exhausted into the tunnel to provide heat in the shaft head frame, but at changing time the air is exhausted directly to the outside because of its dust content. Heat is considered less important than dust control and drying clothes. The entire unit has an automatic control with provisions for manual manipulation.

The air-conditioning unit is powered by a 3-horsepower, 220-volt, 3-phase electric motor. The system requires a maximum of 1,040,000 B.t.u. an hour, obtained from steam piped from boilers in the engine house. The condensate is returned to a receiver in the engine house, pumped to the boilers, and reused as boiler-feed water. Two stoker-fired boilers are maintained; however, only one unit is in use at a time and is kept near its rated capacity for efficient operation. In the summer, all heat is cut off except that needed to provide hot water for the showers and heat for the mine-clothes room.

The exhaust fan is powered by a 1/2-horsepower, 220-volt, 3-phase, electric motor and is capable of exhausting 6,000 cubic feet of air a minute.

Lighting

The entire change house, including the tunnel to the shaft, is illuminated by 220-volt, 100-watt, standard incandescent electric-light bulbs in glass-enclosed fixtures. Tunnel wall plug-in sockets on a 110-volt circuit are provided every 50 feet.

The large rooms have two lighting circuits, one for aisle lights and one for general room illumination. Aisle lights are spaced on 12-foot centers. The street-clothes room has two lights on 6-foot centers above each row of benches. The mine-clothes room has three lights on 5-foot centers above each row of benches.

All wiring is in metal conduit, and all circuits are adequately protected against overloads by individual reset relay switches and main power fuses. Aisle lights are controlled by wall toggle switches near door entrances, and the main power switch and the room control switch box are in the attendant's room.

In addition to the lighting circuits, several wall plug-in sockets on a 110-volt circuit are provided in various rooms to serve a vacuum cleaner that is used to remove dust accumulations.

Mine-Clothes Facilities

The mine-clothes room is equipped with facilities for 150 clothes hooks and chains (fig. 20) hung on angle-iron ceiling supports and pipe-rack stands. Chain hangers are spaced 20 inches apart. Stands are provided in 8 rows 6 feet apart. Clothes hooks are hung by a single length of chain. One end is fastened to the hook, the other end is passed through a pulley mounted on the ceiling support, then run under the pipe rack and hooked through a ring spacer mounted on the chain. The spacer is so placed as to suspend the hook 12 feet above the floor when fastened.

The pipe-rack stands are constructed of 1-1/2-inch pipe mounted 39 inches above the floor. Benches, 18 inches high, are mounted on 3-inch pipe uprights midway between the stands. Benches are constructed of 2- by 12-inch pine planks with a painted finish. One refuse can is maintained under each pipe rack stand.

The short stairway at the end of the room is equipped with handrails and non-slip treads.

An electric clock, a cage signal buzzer, and tele-talk address loudspeakers are located near the stairway to expedite the loading of cages and otherwise aid the mine supervisors.

Charged lamps are available from a rack, with a capacity of 126 lamps, recessed in the hallway wall. A portable lamp rack for used lamps is rolled out of the lamp room into the hallway for miners coming off shift.

The boot wash, at the hallway entrance to the mine-clothes room, is equipped with five sprinkler heads for washing mine boots and a shower sprinkler-type head in one corner for washing rubber coats and pants. Figure 21 shows the boot wash.

Rooms for Mine Officials

Mine officials are provided with quarters accessible from the change-house entrance stairway and from the mine-clothes room. They are provided with a street-clothes room with an adjacent office for the captain's use, shower, toilet, and mine-clothes room with an entrance into the employees' mine-clothes room.

The street-clothes room is equipped with a conference table and five lockers mounted on a bench rack. The shower contains three heads, and the toilet room has a toilet stool, urinal, and small porcelain sink. The mine-clothes room is equipped with five chain hanger hooks, bench, table and chair, first-aid cabinet, and tele-talk speaker system connecting the office, hoist room, shops, employees' change rooms, shaft landing, and the various shaft stations.

Street-Clothes Facilities

The street-clothes room is equipped with 150 basket-type (fig. 22) chain hangers. The chains are hung on ceiling supports and pipe-rack stands similar to those in the mine-clothes room. The baskets may be hung on 12-inch centers on each side of pipe-rack stands, but at present only 8 baskets on a side, on 24-inch centers, are being used. The pipe-rack spacing and bench construction are similar to those in the mine-clothes room. Refuse cans are provided under each stand.

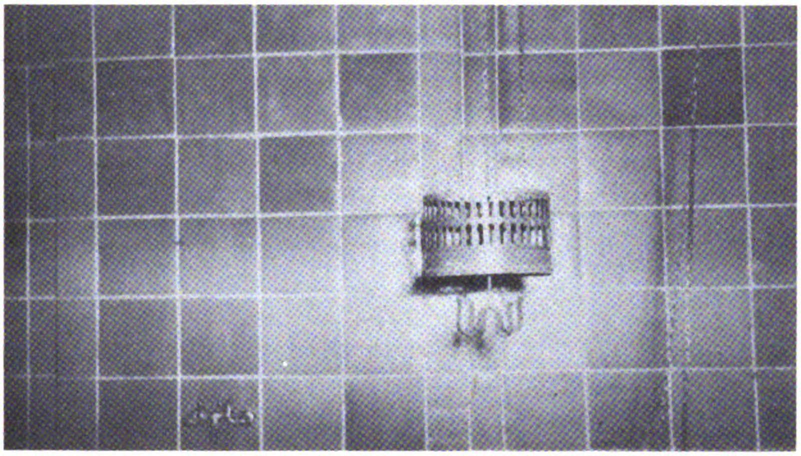

Figure 22. - Mine C change house, clothes basket hanger.

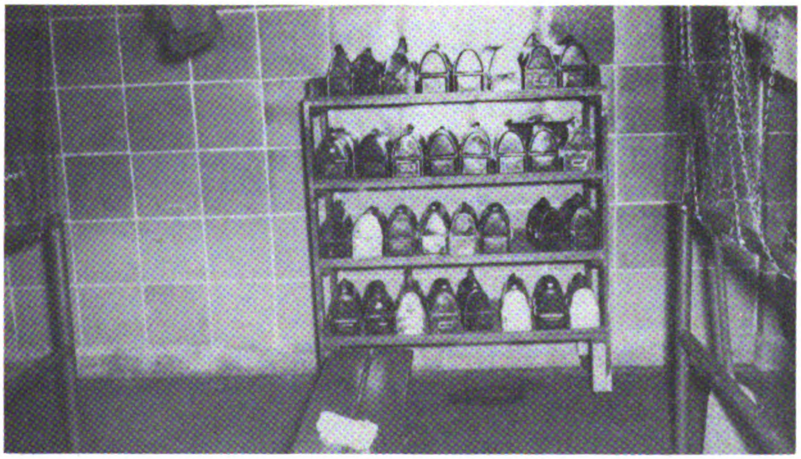

Figure 23. - Mine C change house, dinner bucket wagon.

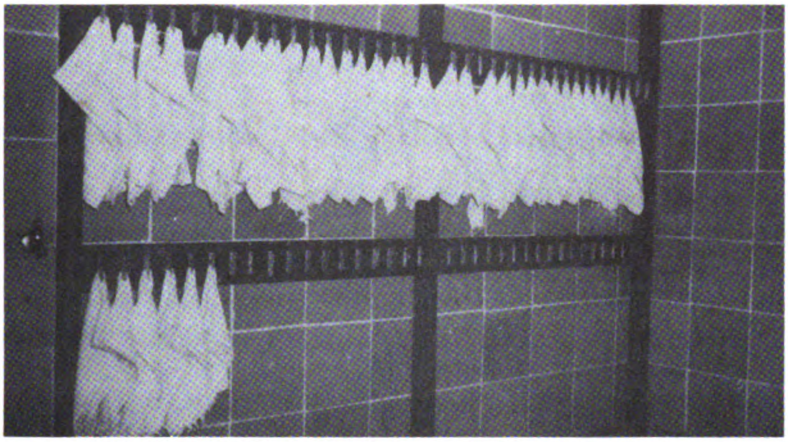

Figure 24. - Mine C change house, towel rack.

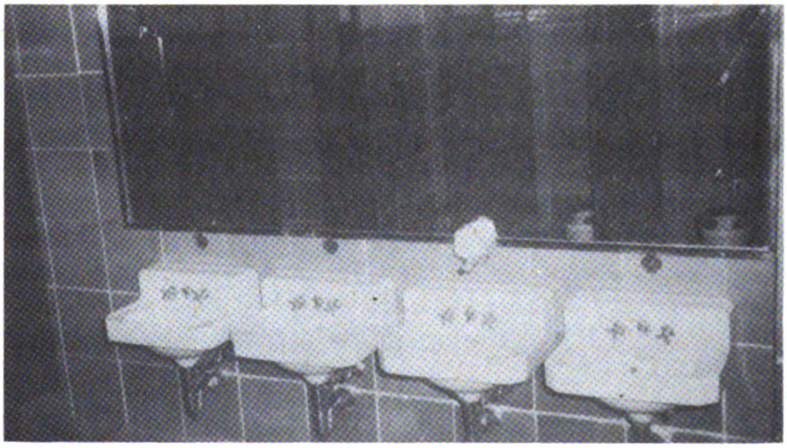

Figure 25. - Mine C change house, toilet and washroom in street-clothes section.

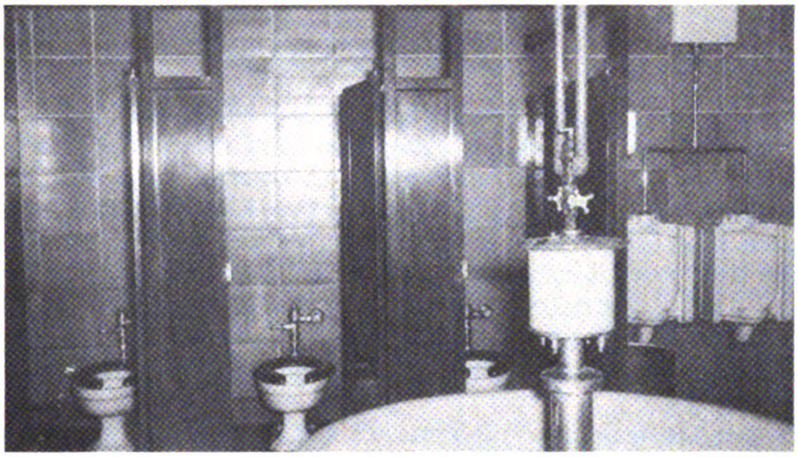

Figure 26. - Mine C change house, toilet facilities in mine-clothes section.

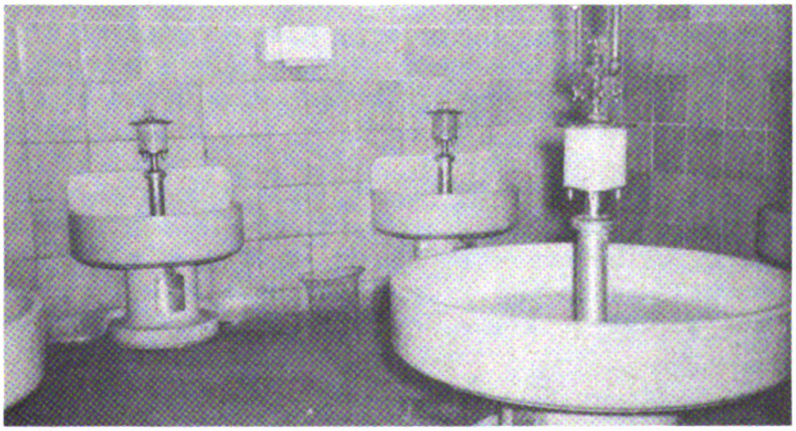

Figure 27. - Mine C change house, washing facilities in mine-clothes section.

To facilitate the handling of dinner buckets on change of shifts, a lunch wagon (fig. 23) is used. The dinner buckets are deposited on the wagon in the mine-clothes room and are then wheeled into the street-clothes room by the change-house attendant, so that the miners can obtain their buckets after they have bathed and changed into their street clothes.

Bathing Facilities

Shower heads, valves, liquid-soap dispensers, and foot railings are mounted on a center-partition stand of tile and plaster construction and on the walls in the shower room. Soap solution is mixed and stored in an overhead drum and piped to the shower room. Twenty-six ball-socket, jet-spray type, shower heads are provided; they are mounted 6-1/2 feet above the floor and have individual hot and cold water mixing valves. Hot water is piped from the engine house and passes through a thermostatically controlled mixing valve limiting the temperature to 130° F. The foot railing is 1-1/2 inch brass pipe extended 13 inches above the floor and 9 inches out from the walls.

Clean towels are furnished daily to underground employees. They are hung on a towel rack (fig. 24) equipped with 72 clothes-pin holders in a drying room between the showers and the street-clothes room. The towels are deposited with the change house attendant after they have been used.

All floors throughout the change house are sloped adequately to the drains, and water-hose connections are conveniently located in the various rooms for washing floors.

Toilet Facilities

The toilet and wash room of the street-clothes section is provided with six porcelain stools in metal booths with doors, an upright-porcelain urinal, four porcelain sinks, one liquid-soap dispenser, and a large wall mirror (fig. 25). The stools are flushed manually, and the urinal is flushed by an automatic overflow trip valve.

The toilet and wash room of the mine-clothes section is equipped with three porcelain stools in metal booths with doors, two upright porcelain urinals, a large circular wash bowl, four half-round wall-type wash bowls, liquid-soap and paper-towel dispensers, and refuse cans. Figure 26 shows a view of the toilet facilities, and figure 27 shows a view of the washing facilities in the room.

General Sanitation

The surface boss at the mine supervises the maintenance and upkeep of the change house. A change-house attendant, who also takes care of the lamps, is employed for each shift.

The floor of the mine-clothes section of the change house is washed with water after each change of shifts and is swept after each dinner period. The floor of the street-clothes section is swept daily and washed twice a week.

Toilet stools and seats, urinals, wash basins, and fountains are scoured with a disinfectant cleaner, and waste receptacles are emptied once a shift. Walls and lighting fixtures are washed with soap and water every 3 months.

The air-conditioning ventilation unit controls humidity and room temperatures, airs and dries clothes, removes dust, and removes undesirable air from toilet rooms, showers, and the lamp room.

Miners travel between the shaft and change house without exposure to outside weather conditions.

Fire Prevention and Control

All heat is piped to the building. Electric wiring is in metal conduits and adequately protected against overloads.

Water hose and connections normally used for washing floors are readily available in event of fire. A 1-quart carbon tetrachloride fire extinguisher is provided near the lamp rack at the tunnel entrance to the change house. Similar extinguishers may be obtained from the shops upstairs or from the laboratory.

The change house has two exits to the outside, with several other exits available along the tunnel connecting the change house to the engine house, office, and the shaft.

MINE D

General Information

This change house was designed to accommodate an ultimate capacity of approximately 700 underground employees and is the largest one in the Lake Superior district. The construction of the main structure was completed during the latter part of 1941, but the equipment for it is still being installed as the mine expands and needed materials become available. Surface employees are provided with separate quarters in another wing of the main building.

With the shaft head frame on the open side, all of the mine surface plant is housed in a one-story steel and masonry building forming the other three sides of a rectangle. The building houses, under one roof, the surface and the underground change houses, a warehouse, oil-storage space, a heating plant, the shops, a garage, the mine offices, and the generating, air-compressing, and hoisting equipment. The part of the change house assigned to underground employees is an entire wing of the building, shown in figure 28, which is connected by a 110-foot, two-level, underground concreted tunnel (fig. 29) to the shaft cage-hoisting compartment. Along the back or closed end of the rectangle is a large parking lot, which has been graded and surfaced with gravel. A concrete walk connects the parking lot with the change-house entrance. The grounds around the building have been landscaped and are well-kept.

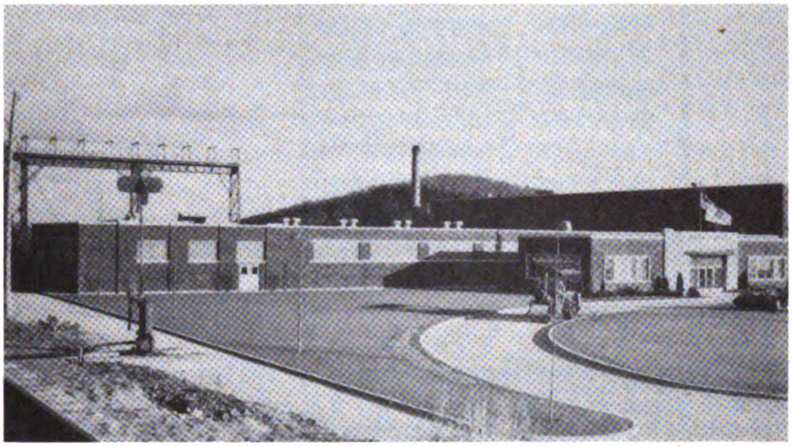

Figure 28. - Mine D change house, general view.

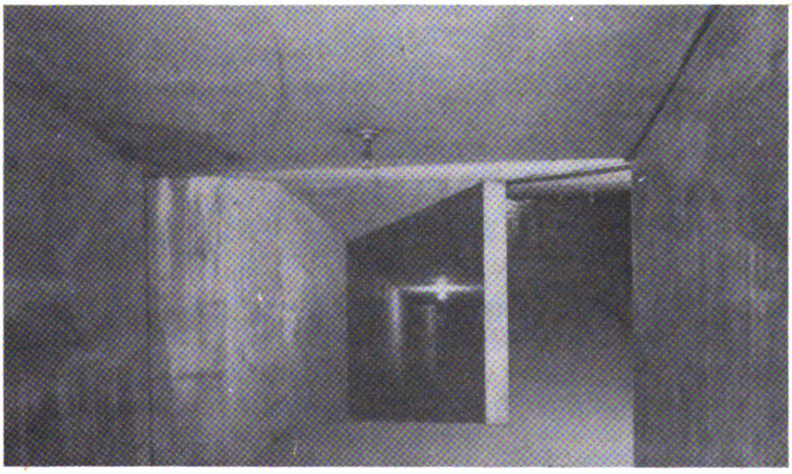

Figure 29. - Mine D change house, tunnels to upper and lower cage compartments.

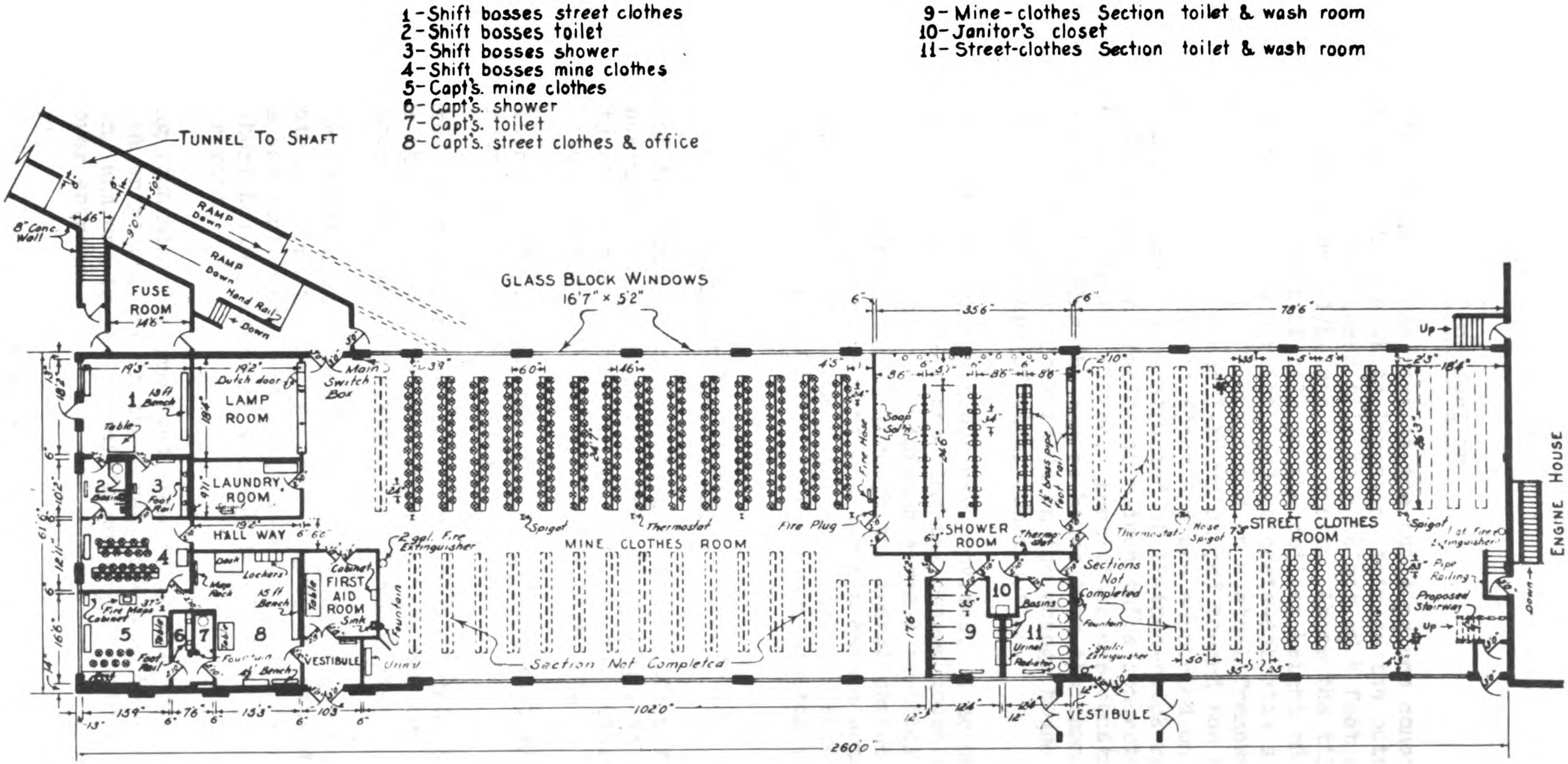

Figure 30. - Mine D change house, floor plan.

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Construction

The walls of the change-house part of the building are constructed of 8-1/2 inch, red, face brick with white limestone trim on the outside, and of 3-7/8 inches of glazed, buff-colored tile to a height of 8 feet on the inside, the two being separated by a 2-1/8-inch air space. Above the tile are 5 feet of glass block topped by 2 feet of tile to the ceiling height of 15 feet. The roof is constructed of 4-inch reinforced concrete-asbestos slab covered by a pitch and gravel finish. It is supported on a steel framework of 12-inch I-beam joists on 24- by 12-inch cross I-beams sloped toward the center of the roof. Cross beams are spaced 20 feet apart and are supported on 12-inch H-columns. Foundation footings are constructed of 12-inch-thick reinforced concrete, and the floors are constructed of 6-inch thick concrete slabs, having a coved base and a non-slip trowel finish. Partitions are constructed of 6-inch tile. The wall partitioning the engine house from the change house is built of 8-1/2-inch thick cinder block faced on the change house side with the glazed tile. Doors and frames are of steel construction.

Several entrances to the change house are provided. Mine employees have a main entrance through a vestibule connecting the change house and offices; another, in process of construction, is through a small vestibule adjacent to the engine house; and a third entry is through the tunnel connecting the change house and shaft. The mine superintendent and captain have a separate entrance to their change rooms. The shift bosses' change rooms also have a separate entrance. A door is provided between the change-house and the engine-house sections of the building.

Interior Arrangement

A floor plan of the change house is shown in figure 30; a few minor alterations were made during or since erection. The change house is divided into three parts - a street-clothes section on one end, a mine-clothes section in the center, and a mine-supervisors' section at the other end.

The street-clothes section consists of a large street-clothes hanger room with an adjacent room for toilet facilities.

The mine-clothes section consists of a large mine-clothes hanger room with separate rooms for shower and for toilet facilities at one end, and for a first-aid station, a laundry, and lamp facilities at the other end.

The mine-supervisors' section has quarters for the captain and superintendent and separate quarters for shift bosses. Both are provided with rooms for street clothes and conference meetings, showers, toilet facilities, and mine clothes. A short hallway connects the supervisors' section to the miners' mine-clothes hanger room.

Three drinking fountains are provided, one in the street-clothes room near the toilet-room entrance, one in the mine-clothes room on the first-aid room wall partition, and one in the captain's and superintendent's change rooms near the shower entrance.

Construction

The walls of the change-house part of the building are constructed of 8-1/2 inch, red, face brick with white limestone trim on the outside, and of 3-7/8 inches of glazed, buff-colored tile to a height of 8 feet on the inside, the two being separated by a 2-1/8-inch air space. Above the tile are 5 feet of glass block topped by 2 feet of tile to the ceiling height of 15 feet. The roof is constructed of 4-inch reinforced concrete-asbestos slab covered by a pitch and gravel finish. It is supported on a steel framework of 12-inch I-beam joists on 24- by 12-inch cross I-beams sloped toward the center of the roof. Cross beams are spaced 20 feet apart and are supported on 12-inch H-columns. Foundation footings are constructed of 12-inch-thick reinforced concrete, and the floors are constructed of 6-inch thick concrete slabs, having a coved base and a non-slip trowel finish. Partitions are constructed of 6-inch tile. The wall partitioning the engine house from the change house is built of 8-1/2-inch thick cinder block faced on the change house side with the glazed tile. Doors and frames are of steel construction.

Several entrances to the change house are provided. Mine employees have a main entrance through a vestibule connecting the change house and offices; another, in process of construction, is through a small vestibule adjacent to the engine house; and a third entry is through the tunnel connecting the change house and shaft. The mine superintendent and captain have a separate entrance to their change rooms. The shift bosses' change rooms also have a separate entrance. A door is provided between the change-house and the engine-house sections of the building.

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Ventilation and Heating

A generalized plan of the ventilation and heating systems for the change house is shown in figure 31. Four systems of ventilation and heating are employed as follows: (1) an air-conditioning system for ventilating and heating the large change rooms, (2) steam radiators for heating the small rooms and vestibules, (3) individual floor-type unit ventilators for the intermediate-sized rooms, and (4) an overhead-type unit heater for the large shower room, in addition to natural air circulation from the street-clothes section. All doors are self-closing, and individual rooms are separately ventilated and heated with the exception of the shower room.

The large mine-clothes room has an air-conditioning unit suspended over the tunnel entrance. A fresh-air inlet to the unit is through a vent opening in the roof. Fresh air is mixed with recirculated air, filtered, heated, and forced through a blower duct along the center of the room near the ceiling. By this means 16,000 cubic feet of conditioned air a minute is distributed along the room through a central duct having eight regularly spaced grille openings on each side. Room air for recirculation is drawn through perforated circular-manhole cover plates in the floor into a tapering concrete return duct terminating in a riser in the laundry room at the far end of the mine-clothes room. The riser returns the air to the conditioning unit through an overhead duct having a built-in humidity control. Eight gravity-type outlet vents in the roof are spaced in pairs over the center of the room. The concrete floor duct slopes toward a small sump equipped with a drain pipe to facilitate washing out dust accumulations and is accessible through manholes at each end. The thermostat control is on a steel column in the center of the room and is set at 78° F.

The street-clothes room has an overhead suspended air-conditioning unit centrally located at one end of the room. It forces 4,600 cubic feet of conditioned air a minute down a central aisle through twin grille openings 16 by 22 inches. Recirculated air is drawn through a riser duct on the engine-room wall in back of the unit. The riser is suspended 8 inches above the floor. Fresh air to the unit is through an overhead roof duct. Two roof gravity ventilators are provided, one in each corner of the room adjacent to the engine-room wall. The temperature is regulated at 75° F. by a thermostat mounted on a steel column in the center of the room.

The shower room has an individual, thermostatically controlled, overhead unit heater directing 2,600 cubic feet of air a minute toward the outer-wall side of the room. The thermostat controlling the heater is near the center of the room mounted on a steel column and set at 85 F. Two ceiling grilles are provided through the street-clothes room wall. A large ceiling grille, together with a large floor-vent recirculation duct, is provided through the wall behind the unit heater to a janitor's closet interposed between the two main toilet rooms. The janitor's closet has an outlet vent and fan for exhausting 3,500 cubic feet of air a minute through the roof.

The two main toilet rooms are equipped with steam-radiator heaters and have ventilation provided through ceiling registers from its adjacent street-clothes or mine-clothes room. Outlet ventilation is through floor registers into the janitor's closet.

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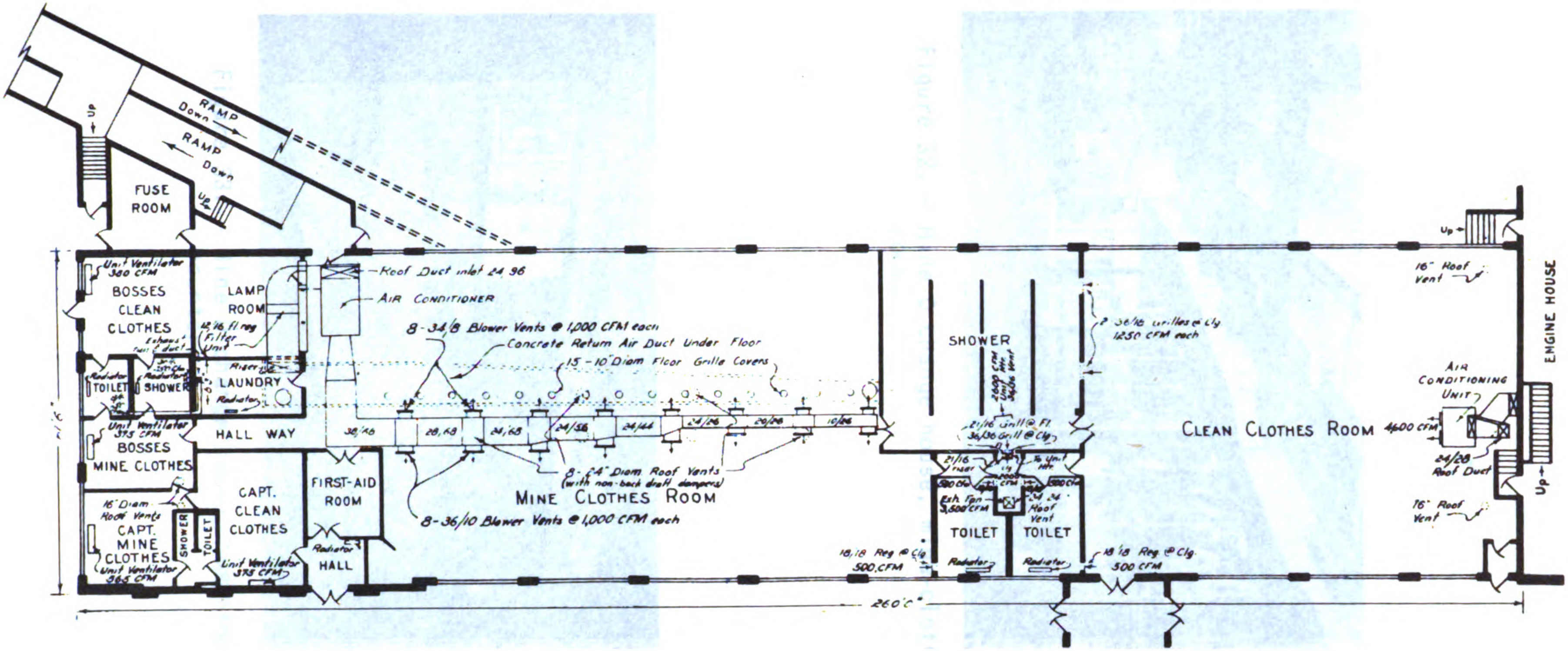

Figure 31. - Mine D change house, ventilation plan.

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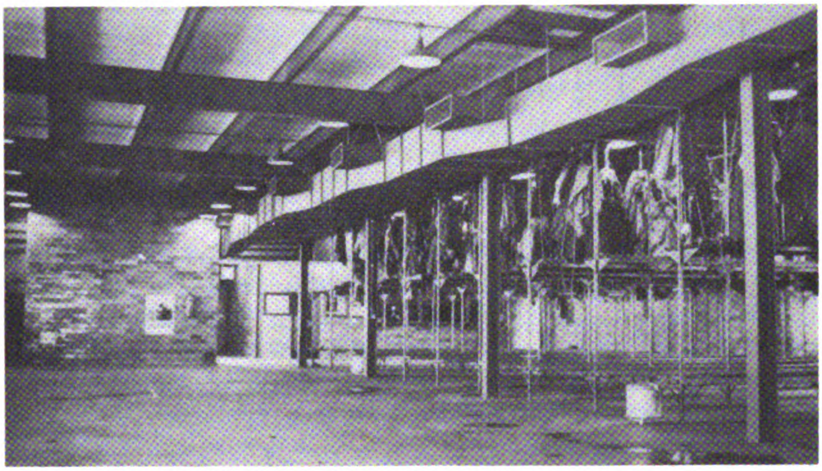

Figure 32. - Mine D change house, mine-clothes room.

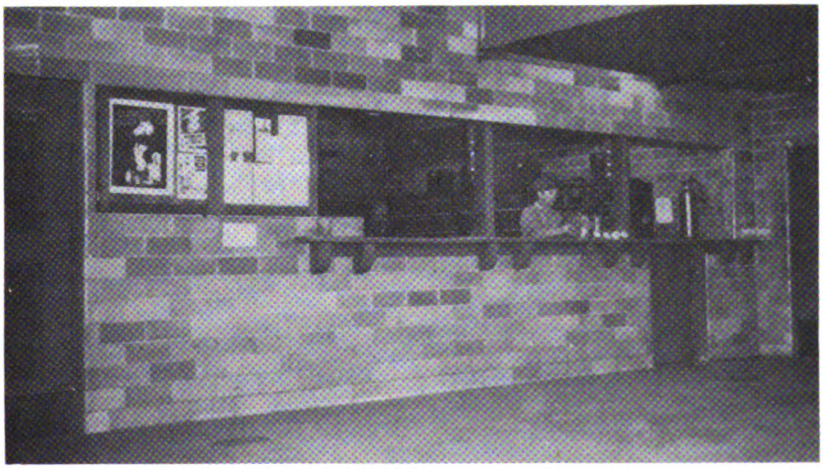

Figure 33. - Mine D change house, lamp-room counter.

The supervisors' section is ventilated and heated by floor-type thermostatically controlled unit ventilators and radiators as indicated in figure 31.

Lighting

Natural illumination for the change-house part of the building is through glass-block windows, shown in figure 30. Artificial illumination is provided by incandescent electric-light bulbs with enameled floodlight-type reflecting fixtures hung 13-1/2 feet above the floor. The larger rooms are equipped with 300-watt bulbs; the smaller rooms and the tunnel are equipped with 200-watt bulbs; all lighting circuits carry 110-volts alternating current.

The street-clothes room is equipped with lights on 15-foot center in rows 10 feet apart. The mine-clothes room is similarly equipped, with the rows 12 feet apart. Three hundred-watt bulbs are hung in the shower room on 10-foot centers in rows 10 feet apart. Two ceiling lights are hung 10 feet apart in each toilet room, and double plug-in-type wall sockets are provided on the wall between the sinks. Wall sockets are also provided in the larger rooms and in the supervisors' section.

All wiring is in metal conduit, and individual circuits are provided with reset relay overload protection. The master control box with room switches is near the tunnel entrance in the mine-clothes room. The supervisors' section is equipped with individual room toggle-type wall switches mounted conveniently near door entrances.

Mine-Clothes Facilities

A view of the mine-clothes hangers, installed on one side of the mine-clothes room, is shown in figure 32. The room eventually will be equipped on both sides with 618 hangers on 15 pipe-rack stands. The rows are spaced 6 feet apart and have chain hangers staggered in rows extending 12 inches from the centerline of the racks. Unlike the racks in the street-clothes section, these have a built-in boot shelf of 1-inch wire-mesh screen supported by angle-iron bracing welded to the pipe-rack uprights at a height of 6 feet 3 inches. A workman's clothes are hung on a 4-prong hook attached to a chain and suspended at a height of 13 feet when the hanger is pulled up and the chain is hooked to an eye on the edge of the boot shelf. Each chain is threaded through a single ceiling pulley.

Covered refuse cans, shown in figure 32, are placed conveniently along the center aisle. A urinal trough is in one corner of the room partly screened from view.

Electric cap lamps are handled at the end of the mine-clothes room near the tunnel entrance. (Fig. 33).

Rooms for Mine Officials

The mine captain and superintendent have quarters separate from the shift bosses. Both sections are provided with a street-clothes room, shower, toilet, and mine-clothes room.

The captain and superintendent's street-clothes room serves as the captain's office and for conferences as well as for changing facilities. It is equipped with a rack for underground maps, desk, large table, several chairs, mine telephone, four clothes lockers, two benches, and wall hooks for hanging clothing. A toilet is in a small room and an adjacent shower room has two shower heads and a footrail. A small porcelain wash basin, paper-towel dispenser, mirror, and drinking fountain are mounted on the partition dividing the toilet and shower along the passageway between the street-clothes and mine-clothes rooms. The mine-clothes room is provided with eight chain hangers, wall hooks for clothing, table, cabinet for incidentals, and fire-map case on the wall over a small tracing table (fig. 34). The fire-map case contains surface and underground maps showing the locations of fire hydrants, hose, extinguishers, underground workings, ventilation system and a list of trained mine-rescue men with their addresses and telephone numbers.

The shift bosses' street-clothes room is equipped with wall hooks, a long bench, several chairs, and a table. The toilet room contains a single porcelain toilet stool in a metal booth, small upright porcelain urinal, and porcelain wash basin. The shower is provided with three shower heads, soap-solution dispensers, a tray for solid soap, and a footrail. The mine-clothes section is equipped with two benches and pipe-rack chain clothes hangers having a boot shelf provisions have been made for 22 hangers. A table, desk, chair, and mine telephone are also in this room.

Street-Clothes Facilities

Figure 35 is a view of the street-clothes hanger facilities, showing the room air-conditioning unit in the background. The facilities include benches of 2- by 10-inch plank on angle-iron framework supported by 1-1/2-inch transverse pipe-racks that are braced by welding lengths of 1-1/2-inch pipe to them and the ceiling beams. Hanger rows are spaced 5 feet apart, and hanger chains are staggered in rows extending 15 inches out from the centerline of the racks to prevent rubbing of chains against clothing. One end of a chain is attached to a basket, threaded through two ceiling pulleys, looped to within 4 feet of the floor, and the other end is fastened to the underside of the hook end of the basket. A hook is mounted on the chain to engage an eye on the pipe rack when the basket is raised to a height of 13 feet. Such an arrangement prevents clothes from being lowered to the floor accidentally.

Bathing Facilities

The main shower room has two-way swinging, double, self-closing doors at both entrances. The 74 shower heads in the room are a ball-joint jet-spray type suspended 12 inches from the walls and 7-1/2 feet above the floor. The heads are spaced about 30 inches apart and have liquid-soap push-button dispensers between every other shower. Hot and cold water-control valves are mounted 5 feet high. Hot water for bathing is piped from the boiler room, which is in a separate part of the building. At present, only a part of the shower room is utilized. This part has been equipped with footrails of 1-1/2-inch brass pipe mounted 11 inches from the walls and 14 inches high. The remainder of the room will be completed when needed materials become available.

The floor slopes to grooves leading to drains (fig. 36).

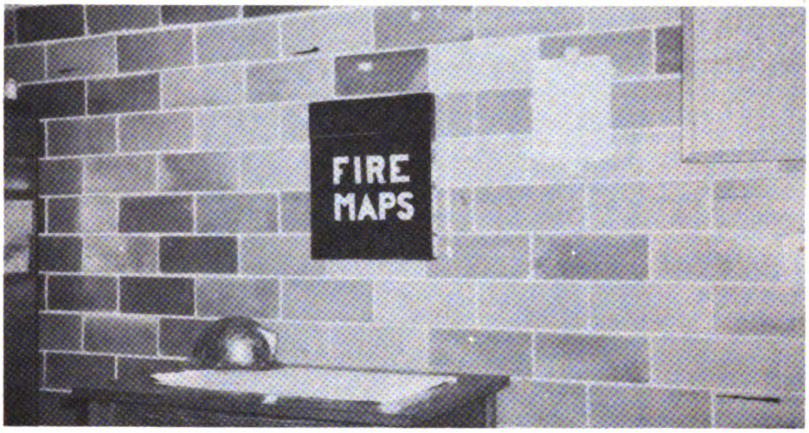

Figure 34. - Mine D change house, fire maps in captain's mine-clothes room.

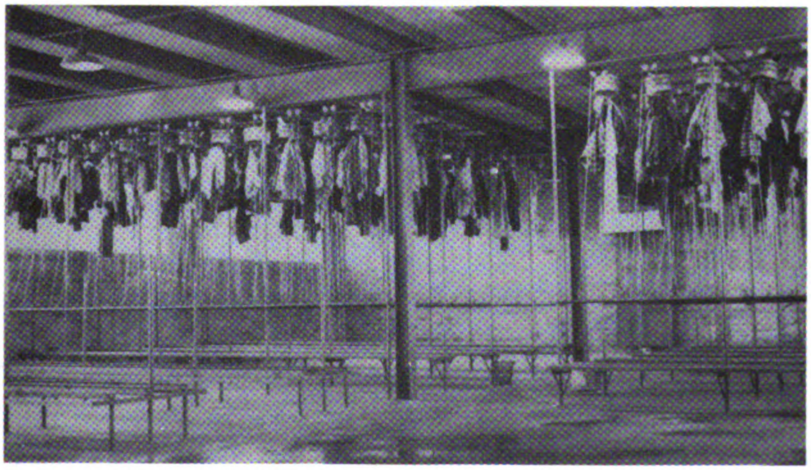

Figure 35. - Mine D change house, street-clothes room, air-conditioning unit in right background.

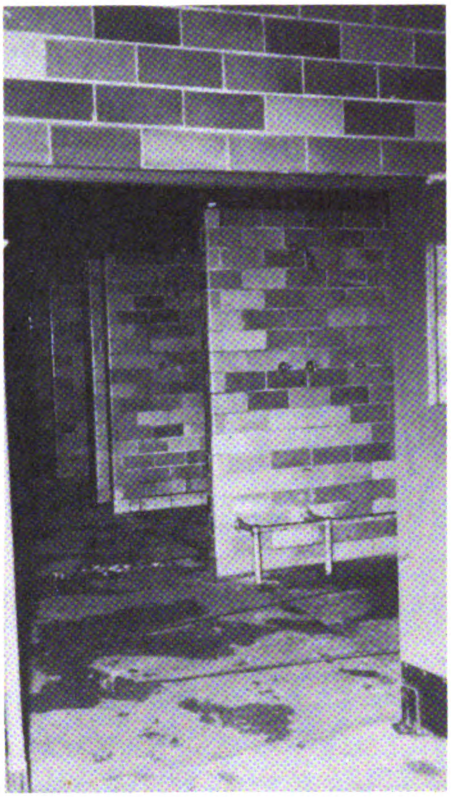

Figure 36. - Mine D change house, shower room.

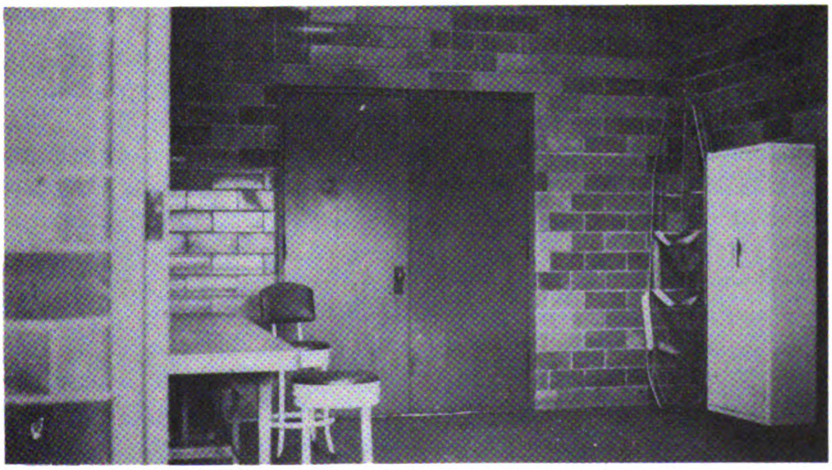

Figure 37. - Mine D change house, first-aid room.

Toilet Facilities

Both the mine-clothes and the street-clothes sections have separate toilet facilities in similar rooms; each is equipped with six porcelain stools in metal booths with doors, a 5-foot horizontal porcelain urinal trough, and two small porcelain wash basins. The stools occupy one side of a room, and the urinal and basins occupy the other side. The stools and urinals are flushed manually, and bar deodorants are kept in containers over the urinals.

General Sanitation

The surface boss supervises the maintenance and upkeep of the change house. A change-house attendant, a lamp man, and a watchman are employed on each shift. All floors and benches are washed after each shift change. The toilets, wash basins, urinals, and drinking fountains are cleaned with a disinfectant-type cleaner once a day. Adequate refuse cans with self-closing lids are kept at convenient points throughout the building and are emptied once a shift.

The air-conditioned ventilation maintains constant room temperatures, removes dust, and airs and dries clothing.

Miners travel between the shaft and change house without exposure to outside weather conditions.

A first-aid room (fig. 37) is incorporated as an integral part of the change house.

Fire Prevention and Control

The building is of fire-resistant construction. All electric wiring is in metal conduit, and circuits are properly protected against overloads or short circuits by reset relay switches and fuses. All heat is piped to the change-house sections of the building at ceiling height and away from combustible material.

A 100-foot length of 1-1/2-inch fire hose on a reel is maintained in both the mine-clothes and street-clothes sections; connections to the water supply are provided nearby. In addition, various types of fire extinguishers ranging from 1-pint carbon tetrachloride-type to 2-1/2-gallon carbon dioxide and soda-acid types are maintained near door entrances of the various rooms. Garden hose and spigot connections, ordinarily used to wash the floors, are also available.

SUMMARY

Change houses are a vital part of each mining operation in the Lake Superior district, and in each instance such facilities were modern at the time of their construction. This circular gives information as to only a few of the more recently constructed change houses at underground mines. Those described and many others are a credit to the Lake Superior district. The present tendency is to house all surface equipment, offices, and warehouses in one building, and, in such instances, the plant inside and outside showed excellent housekeeping.

The change houses are ventilated, heated, and air-conditioned in keeping with the seasonal changes in temperature and other requirements. They are supplied with pure drinking water, adequate toilet facilities, ample number of shower heads in keeping with the man-cage capacity, and are thoroughly cleaned one to three times daily. Separate rooms are provided for street and mine clothes, but the designs are such as to inconvenience one from entering the street clothes room while dressed in mine clothes.

Each change house described was a fireproof or fire-resistant structure and contained adequate fire-fighting equipment, such as fire hose and chemical fire extinguishers.

Other appurtenances, such as boot baths, foot-bath solutions, frequent clean bath towel supply, enclosed connections to shaft station, adjacent lamp rooms, and connecting first-aid rooms combine to provide comfortable, safe, and sanitary bathing and changing facilities.

BIBLIOGRAPHY

1. White, Joseph H., Miners' Wash and Change Houses: Bureau of Mines Tech. Paper 116, 1915, 27 pp.

2. Kindall, Cleve E., Change Houses in the Lake Superior District: Bureau of Mines Tech. Paper 289, 1923, 31 pp.

3. Young, Dan S., A Modern Change House on the Gogebic Iron Range: Mining Cong. Jour., August 1939.

4. Satterley, R. D., A Model Plant for the Sherwood Mine: Eng. and Min. Jour., May 1942.

5. Hubbell, A. H., The Mather Mine, a New Show Place for the Iron Country. Eng. and Min. Jour., October 1941.

6. Harrington, D., and East, J. H., Jr., Wash and Change Houses at American Mines: Bureau of Mines Inf. Circ. 7423, 1947, 44 pp.